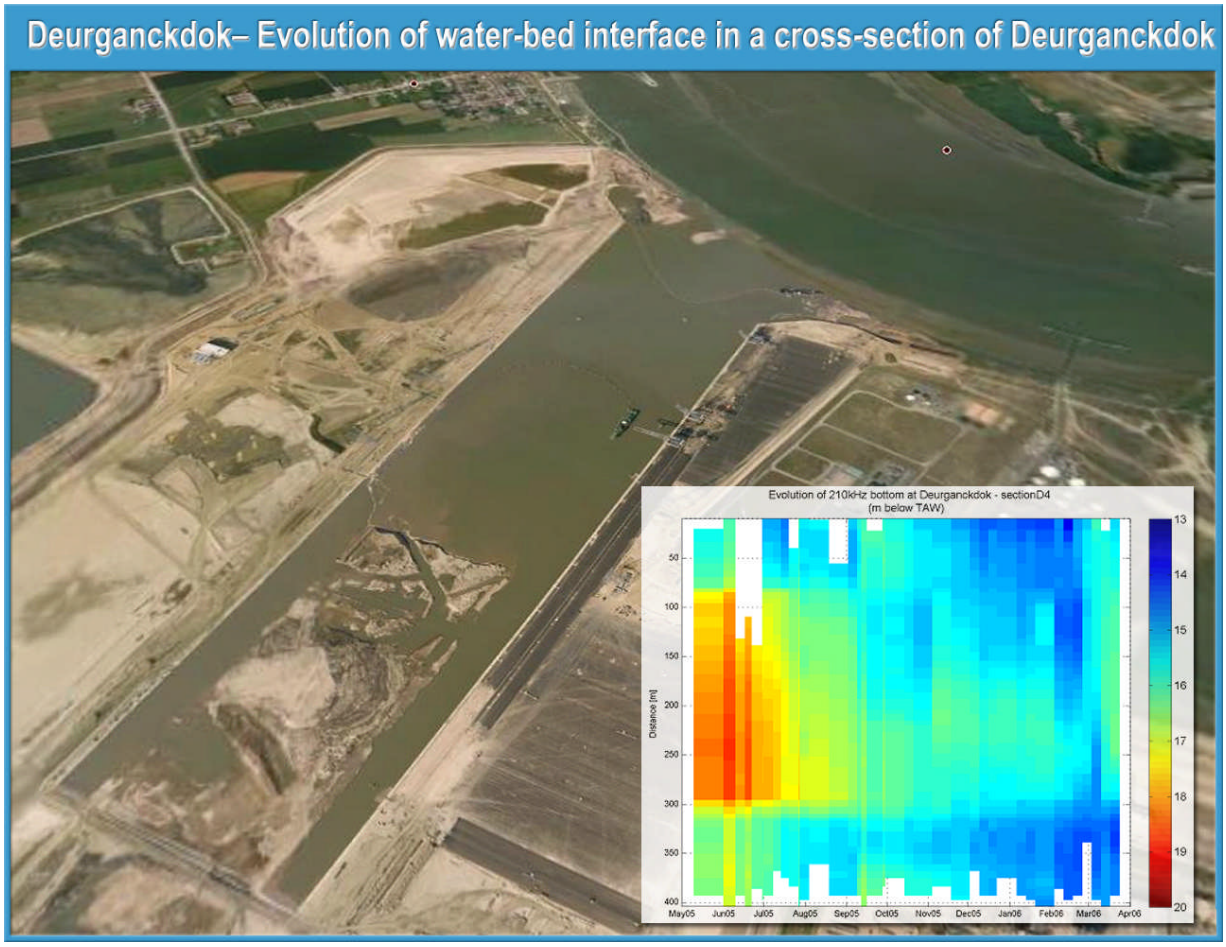
VLAAMSE OVERHEID

DEPARTEMENT MOBILITEIT EN OPENBARE WERKEN
WATERBOUWKUNDIG LABORATORIUM

Langdurige metingen Deurganckdok 2: Opvolging en analyse aanslibbing

Bestek 16EB/05/04



Deelrapport 1.13 : Sediment balans 01/01/2008 – 31/03/2008

Report 1.13 : Sediment balance 01/01/2008 – 31/03/2008

13 October 2008
I/RA/11283/07.084/MSA

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GLOSSARY

BIS	Dredging Information System used in the Lower Sea Scheldt
d	Density of dredged sediment [kg/dm³]
DGD	Deurganckdok
HCBS	High Concentration Benthic Suspensions
M	mass of dry solids [ton]
ρ_s	density of the solid minerals [kg/dm³]
ρ_w	density of clear water [kg/dm³]
t_{0d}	Reference situation for densimetric analysis (empty dock)
t_{0e}	Reference situation for volumetric analysis (24 March 2006)
TDS	Ton of dry solids [ton]
V	volume of dredged sediment [m³]

1. INTRODUCTION

1.1. The assignment

This report is part of the set of reports describing the results of the long-term measurements conducted in Deurganckdok aiming at the monitoring and analysis of silt accretion. This measurement campaign is an extension of the study "Extension of the study about density currents in the Beneden Zeeschelde" as part of the Long Term Vision for the Scheldt estuary. It is complementary to the study 'Field measurements high-concentration benthic suspensions (HCBS 2)'.

The terms of reference for this study were prepared by the 'Departement Mobiliteit en Openbare Werken van de Vlaamse Overheid, Afdeling Waterbouwkundig Laboratorium' (16EB/05/04). The repetition of this study was awarded to International Marine and Dredging Consultants NV in association with WL|Delft Hydraulics and Gems International on 10/01/2006. The project term was repeated with an extra year from April 2007 till March 2008, 'Opvolging aanslibbing Deurganckdok'.

Waterbouwkundig Laboratorium– Cel Hydrometrie Schelde provided data on discharge, tide, salinity and turbidity along the river Scheldt and provided survey vessels for the long term and through tide measurements. Afdeling Maritieme Toegang provided maintenance dredging data. Agentschap voor Maritieme Dienstverlening en Kust – Afdeling Kust and Port of Antwerp provided depth sounding measurements.

The execution of the study involves a twofold assignment:

- Part 1: Setting up a sediment balance of Deurganckdok covering a period of one year, i.e. 04/2007 – 03/2008
- Part 2: An analysis of the parameters contributing to siltation in Deurganckdok

1.2. Purpose of the study

The Lower Sea Scheldt (Beneden Zeeschelde) is the stretch of the Scheldt estuary between the Belgium-Dutch border and Rupelmonde, where the entrance channels to the Antwerp sea locks are located. The navigation channel has a sandy bed, whereas the shallower areas (intertidal areas, mud flats, salt marshes) consist of sandy clay or even pure mud sometimes. This part of the Scheldt is characterized by large horizontal salinity gradients and the presence of a turbidity maximum with depth-averaged concentrations ranging from 50 to 500 mg/l at grain sizes of 60 - 100 μm. The salinity gradients generate significant density currents between the river and the entrance channels to the locks, causing large siltation rates. It is to be expected that in the near future also the Deurganckdok will suffer from such large siltation rates, which may double the amount of dredging material to be dumped in the Lower Sea Scheldt.

Results from the study may be interpreted by comparison with results from the HCBS and HCBS2 studies covering the whole Lower Sea Scheldt. These studies included through-tide measurement campaigns in the vicinity of Deurganckdok and long term measurements of turbidity and salinity in and near Deurganckdok.

The first part of the study focuses on obtaining a sediment balance of Deurganckdok. Aside from natural sedimentation, the sediment balance is influenced by the maintenance and capital dredging works. This involves sediment influx from capital dredging works in the Deurganckdok, and internal relocation and removal of sediment by maintenance dredging works. To compute a sediment balance an inventory of bathymetric data (depth soundings), density measurements of the

deposited material and detailed information of capital and maintenance dredging works will be made up.

The second part of the study is to gain insight in the mechanisms causing siltation in Deurganckdok, it is important to follow the evolution of the parameters involved, and this on a long and short term basis (long term & through-tide measurements). Previous research has shown the importance of water exchange at the entrance of Deurganckdok is essential for understanding sediment transport between the dock and the Scheldt river.

1.3. Overview of the reports

1.3.1. Reports

Reports of the project 'Opvolging aanslibbing Deurganckdok' and 'Opvolging aanslibbing Deurganckdok 2' for the period April 2006 – March 2008 are summarized in Table 1-1.

Table 1-1: Overview of Deurganckdok Reports

Report	Description
Sediment Balance: Bathymetry surveys, Density measurements, Maintenance and construction dredging activities	
1.1	Sediment Balance: Three monthly report 1/4/2006 – 30/06/2006 (I/RA/11283/06.113/MSA)
1.2	Sediment Balance: Three monthly report 1/7/2006 – 30/09/2006 (I/RA/11283/06.114/MSA)
1.3	Sediment Balance: Three monthly report 1/10/2006 – 31/12/2006 (I/RA/11283/06.115/MSA)
1.4	Sediment Balance: Three monthly report 1/1/2007 – 31/03/2007 (I/RA/11283/06.116/MSA)
1.5	Annual Sediment Balance (I/RA/11283/06.117/MSA)
1.6	Sediment balance Bathymetry: 2005 – 3/2006 (I/RA/11283/06.118/MSA)
1.10	Sediment Balance: Three monthly report 1/4/2007 - 30/06/2007(I/RA/11283/07.081/MSA)
1.11	Sediment Balance: Two monthly report 1/7/2007 – 31/08/2007 (I/RA/11283/07.082/MSA)
1.12	Sediment Balance: Four monthly report 1/09/2007 – 31/12/2007 (I/RA/11283/07.083/MSA)
1.13	Sediment Balance: Three monthly report 1/1/2008 – 31/03/2008 (I/RA/11283/07.084/MSA)
1.14	Annual Sediment Balance (I/RA/11283/07.085/MSA)
Factors contributing to salt and sediment distribution in Deurganckdok: Salt-Silt (OBS3A) & Frame measurements, Through tide measurements (SiltProfiling & ADCP) & Calibrations	

Report	Description
2.1	Through tide measurement Siltprofiler 21/03/2006 Laure Marie (I/RA/11283/06.087/WGO)
2.2	Through tide measurement Siltprofiler 26/09/2006 Stream (I/RA/11283/06.068/MSA)
2.3	Through tide measurement Sediview spring tide 22/03/2006 Veremans (I/RA/11283/06.110/BDC)
2.4	Through tide measurement Sediview average tide 27/09/2006 Parel 2 (I/RA/11283/06.119/MSA)
2.5	Through tide measurement Sediview average tide 24/10/2007 (I/RA/11283/06.120/MSA)
2.6	Salinity-Silt distribution & Frame Measurements Deurganckdok 13/3/2006 – 31/05/2006 (I/RA/11283/06.121/MSA)
2.7	Salinity-Silt distribution & Frame Measurements Deurganckdok 15/07/2006 – 31/10/2006 (I/RA/11283/06.122/MSA)
2.8	Salinity-Silt distribution & Frame Measurements Deurganckdok 15/01/2007 – 15/03/2007 (I/RA/11283/06.123/MSA)
2.9	Calibration stationary equipment autumn (I/RA/11283/07.095/MSA)
2.10	Through tide measurement Siltprofiler winter (I/RA/11283/07.086/MSA)
2.11	Through tide measurement Salinity Profiling winter (I/RA/11283/07.087/MSA)
2.12	Through tide measurement Sediview winter (I/RA/11283/07.088/MSA)
2.13	Through tide measurement Sediview winter (I/RA/11283/07.089/MSA)
2.14	Through tide measurement Sediview winter (I/RA/11283/07.090/MSA)
2.15	Through tide measurement Siltprofiler (to be scheduled) (I/RA/11283/07.091/MSA)
2.16	Salt-Silt distribution Deurganckdok summer (21/6/2007 – 30/07/2007) (I/RA/11283/07.092/MSA)
2.17	Salt-Silt distribution & Frame Measurements Deurganckdok autumn (17/09/2007 - 10/12/2007) (I/RA/11283/07.093/MSA)
2.18	Salt-Silt distribution & Frame Measurements Deurganckdok winter (18/02/2008 - 31/3/2008) (I/RA/11283/07.094/MSA)
2.20	Calibration stationary & mobile equipment winter (I/RA/11283/07.096/MSA)
Boundary Conditions: Upriver Discharge, Salt concentration Scheldt, Bathymetric evolution in access channels, dredging activities in Lower Sea Scheldt and access channels	
3.1	Boundary conditions: Three monthly report 1/1/2007 – 31/03/2007 (I/RA/11283/06.127/MSA)
3.10	Boundary conditions: Three monthly report 1/4/2007 – 30/06/2007 (I/RA/11283/07.097/MSA)
3.11	Boundary conditions: Three monthly report 1/7/2007 – 30/09/2007 (I/RA/11283/07.098/MSA)

Report	Description
3.12	Boundary conditions: Three monthly report 1/10/2007 – 31/12/2007 (I/RA/11283/07.099/MSA)
3.13	Boundary conditions: Three monthly report 1/1/2008 – 31/03/2008 (I/RA/11283/07.100/MSA)
3.14	Boundary conditions: Annual report (I/RA/11283/07.101/MSA)
Analysis	
4.1	Analysis of Siltation Processes and Factors (I/RA/11283/06.129/MSA)
4.10	Analysis of Siltation Processes and Factors (I/RA/11283/07.102/MSA)

1.3.2. Measurement actions

Following measurements have been carried out during the course of this project:

1. Monitoring upstream discharge in the Scheldt river
2. Monitoring Salt and sediment concentration in the Lower Sea Scheldt taken from on permanent data acquisition sites at Lillo, Oosterweel and up- and downstream of the Deurganckdok.
3. Long term measurement of salt distribution in Deurganckdok.
4. Long term measurement of sediment concentration in Deurganckdok
5. Monitoring near-bed processes in the central trench in the dock, near the entrance as well as near the landward end: near-bed turbidity, near-bed current velocity and bed elevation variations are measured from a fixed frame placed on the dock's bed.
6. Measurement of current, salt and sediment transport at the entrance of Deurganckdok for which ADCP backscatter intensity over a full cross section are calibrated with the Sediview procedure and vertical sediment and salt profiles are recorded with the SiltProfiler equipment
7. Through tide measurements of vertical sediment concentration profiles -including near bed highly concentrated suspensions- with the SiltProfiler equipment. Executed over a grid of points near the entrance of Deurganckdok.
8. Monitoring dredging activities at entrance channels towards the Kallo, Zandvliet and Berendrecht locks
9. Monitoring dredging and dumping activities in the Lower Sea Scheldt

In situ calibrations were conducted on several dates (15 March 2006; 14/04/2006; 23/06/2006; 18/09/2006) to calibrate all turbidity and conductivity sensors (IMDC, 2006f & IMDC, 2007l).

1.4. Structure of the report

This report is the sediment balance of the Deurganckdok for the period of 01/01/2008 to 31/03/2008. The first chapter comprises an introduction. The second chapter describes the project. Chapter 3 describes the methodology. The measurement results and processed data are presented in Chapter 4, whereas chapter 5 gives a preliminary analysis of the data.

2. SEDIMENTATION IN DEURGANCKDOK

2.1. Project Area: Deurganckdok

Deurganckdok is a tidal dock situated at the left bank in the Lower Sea Scheldt, between Liefkenshoek and Doel. Deurganckdok has the following characteristics:

1. The dock has a total length of 2750 m and is 450 m wide at the Scheldt end and 400 m wide at the inward end of the dock
2. The bottom of Deurganckdok is provided at a depth of –17m TAW in the transition zones between the quay walls and the central trench. The bottom in the central trench is designed at –19 m TAW.
3. The quay walls reach up to +9m TAW

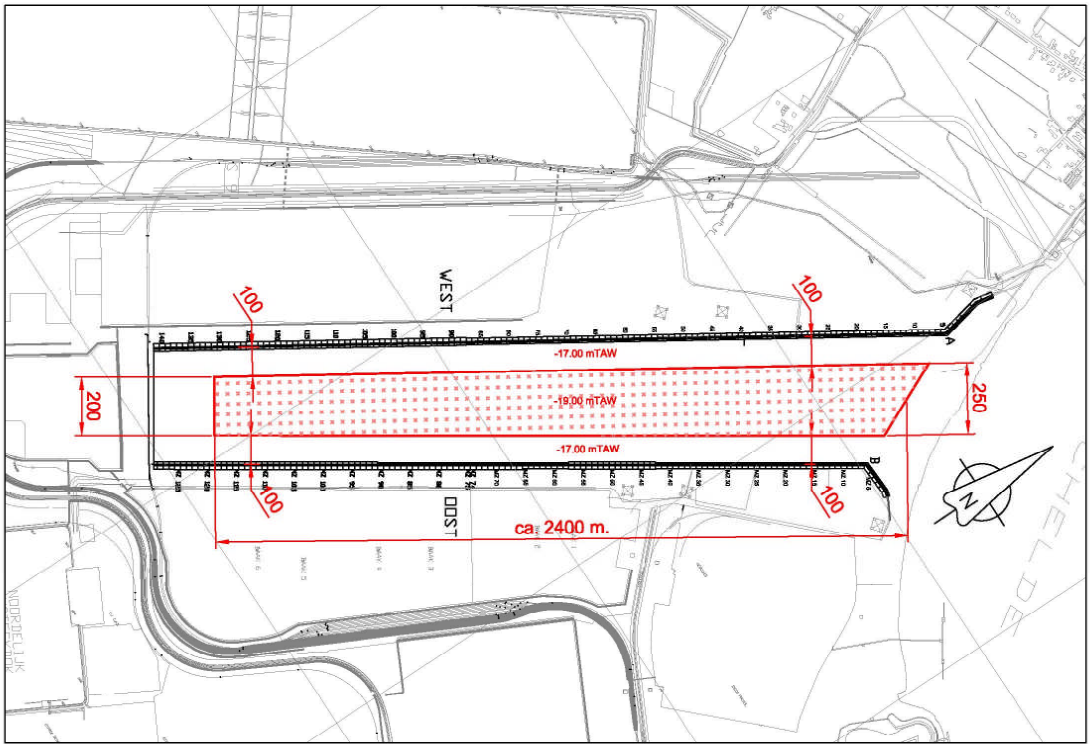

Figure 2-1: Overview of Deurganckdok

The dredging of the dock is performed in 3 phases. On 18 February 2005 the dike between the Scheldt and the Deurganckdok was breached. On 6 July 2005 Deurganckdok was officially opened. The second dredging phase was finalized a few weeks later. The first terminal operations have started since. In February 2007, the third dredging phase started and is finalised by February 2008.

2.2. Overview of the studied parameters

The first part of the study aims at determining a sediment balance of Deurganckdok and the net influx of sediment. The sediment balance comprises a number of sediment transport modes: deposition, influx from capital dredging works, internal replacement and removal of sediments due to maintenance dredging (Figure 2-2).

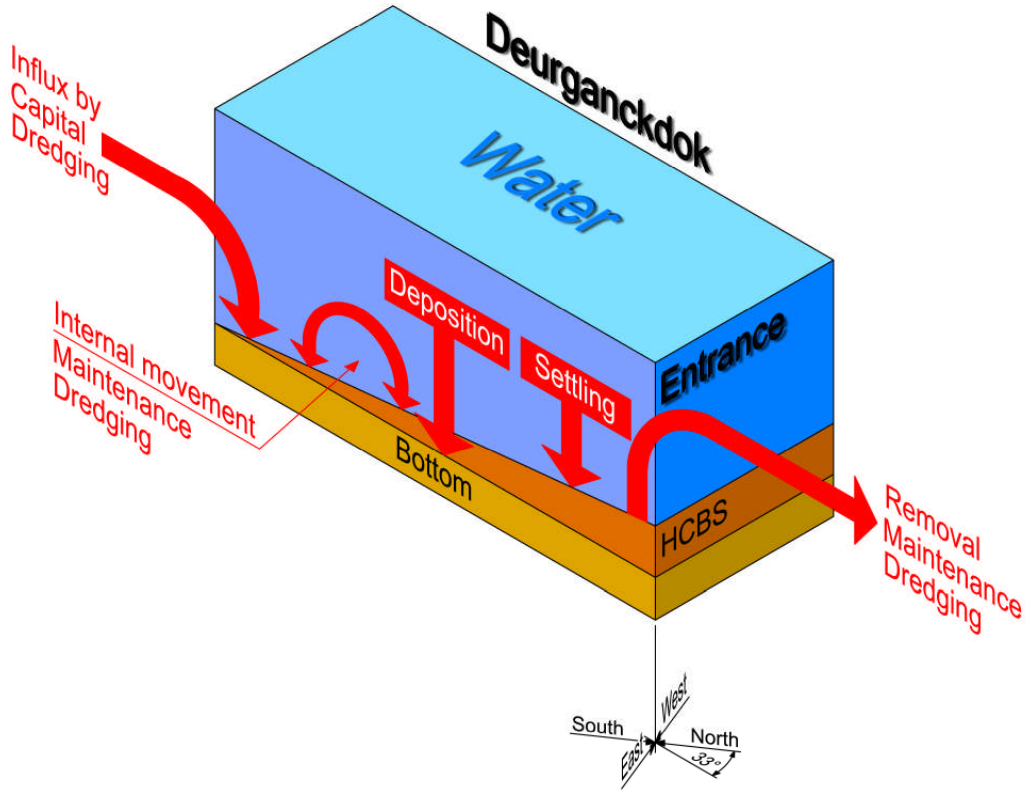

Figure 2-2: Elements of the sediment balance

A net deposition can be calculated from a comparison with a chosen initial condition t_0 (Figure 2-3). The mass of deposited sediment is determined from the integration of bed density profiles recorded at grid points covering the dock. Subtracting bed sediment mass at t_0 leads to the change in mass of sediments present in the dock (mass growth). Adding cumulated dry matter mass of dredged material removed since t_0 and subtracting any sediment influx due to capital dredging works leads to the total cumulated mass entered from the Scheldt river since t_0.

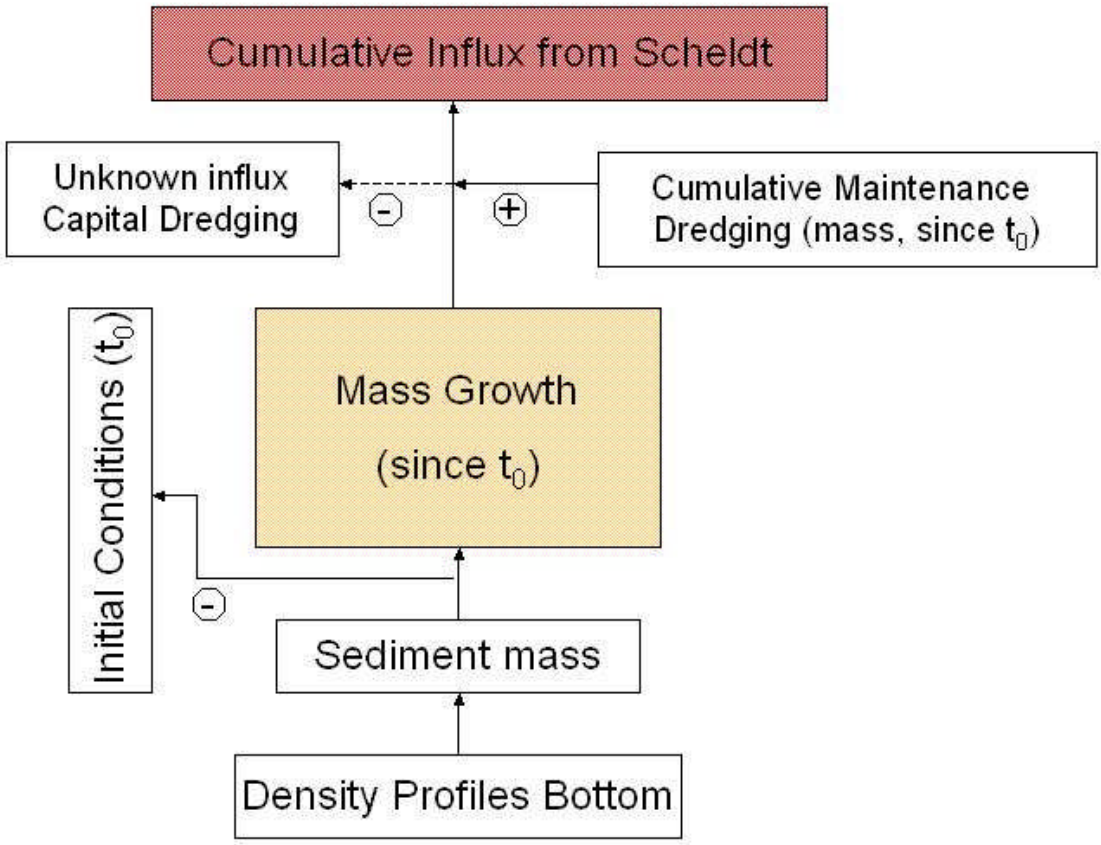

Figure 2-3: Determining a sediment balance

The main purpose of the second part of the study is to gain insight in the mechanisms causing siltation in Deurganckdok. The following mechanisms will be aimed at in this part of the study:

- Tidal prism, i.e. the extra volume in a water body due to high tide
- Vortex patterns due to passing tidal current
- Density currents due to salt gradient between the Scheldt river and the dock
- Density currents due to highly concentrated benthic suspensions

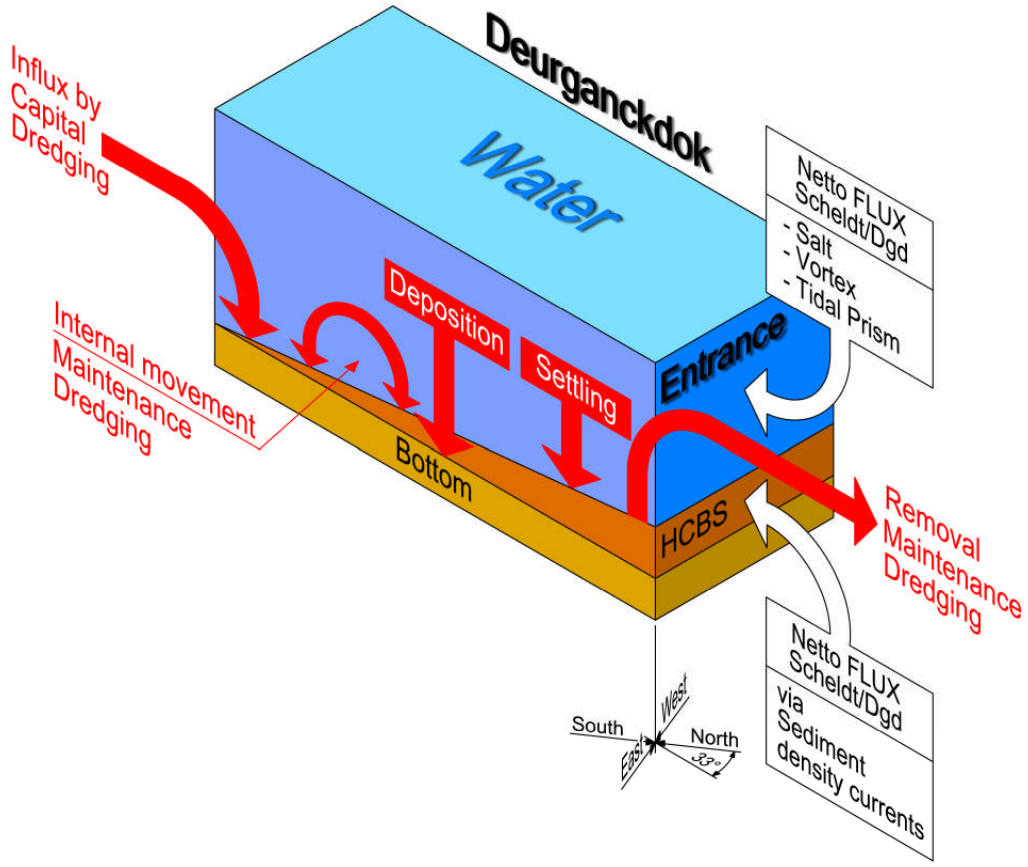

Figure 2-4: Transport mechanisms

These aspects of hydrodynamics and sediment transport have been landmark in determining the parameters to be measured during the project. Measurements will be focused on three types of timescales: one tidal cycle, one neap-spring cycle and seasonal variation within one year.

Following data are being collected to understand these mechanisms:

- Monitoring upstream discharge in the Scheldt river.
- Monitoring Salt and sediment concentration in the Lower Sea Scheldt at permanent measurement locations at Oosterweel, up- and downstream of the Deurganckdok.
- Long term measurement of salt and suspended sediment distribution in Deurganckdok.
- Monitoring near-bed processes (current velocity, turbidity, and bed elevation variations) in the central trench in the dock, near the entrance as well as near the current deflecting wall location.
- Dynamic measurements of current, salt and sediment transport at the entrance of Deurganckdok.
- Through tide measurements of vertical sediment concentration profiles -including near bed high concentrated benthic suspensions.
- Monitoring dredging activities at entrance channels towards the Kallo, Zandvliet and Berendrecht locks as well as dredging and dumping activities in the Lower Sea Scheldt.
- In situ calibrations were conducted on several dates to calibrate all turbidity and conductivity sensors.

3. MEASUREMENTS

3.1. Depth soundings

The client executes dual-frequency echo-sounder measurements every week to every three weeks. F. De Cock (Agentschap voor Maritieme Dienstverlening en Kust – Afdeling Kust) communicated that these measurements are carried out with a 210-33 kC Echo sounder using Qinsy software. The depth sounding measurements are executed in a grid configuration, consisting of sections perpendicular and parallel to the quay wall.

Table 3-1: Overview of the available depth soundings suitable for analysis 01/01/2008 – 31/03/2008

date	***type of measurement***	***signal***	***Source***
24/03/2006*	dual frequency 210-33 kHz	210	Afdeling Kust
8/01/2008	dual frequency 210-33 kHz	210	Afdeling Kust
11/01/2008	dual frequency 210-33 kHz	210	Afdeling Kust
25/01/2008	dual frequency 210-33 kHz	210	Afdeling Kust
15/02/2008	dual frequency 210-33 kHz	210	Afdeling Kust
13/03/2008	dual frequency 210-33 kHz	210	Afdeling Kust

*= reference situation depth soundings: t_{0e}

To calculate a sediment balance it is necessary to analyse the measurements in stationary situation, with no alteration in boundary conditions being dredging operations. Every period is characterized by a depth sounding measurement before (‘inpeiling’) and one after (‘uitpeiling’).

A number of analyses were done using the depth soundings in Table 3-1. The raw depth sounding data was processed in ESRI ArcGIS. The 210 kC signal is used in the following analyses as it gives an indication of the water-bed interface.

A reference level was chosen from all depth sounding measurements, effectively the earliest most complete measurement. This turned out to be the measurement on 24 March 2006. This will be considered as a reference situation, initial condition t_{0e}.

A number of analyses were performed in ArcGIS 9 and a Matlab environment to produce maps, figures and tables with relevant information concerning elevation, elevation changes and volumetric growth (§4.2 to §4.4).

3.2. Density measurements

Navitracker was used to perform density measurements. Density measurements are necessary to calculate a sediment balance of dry weight of sediment per surface unit.

The Navitracker is a patented system to measure the density of fluid mud suspensions, by means of a gamma-density meter. It has been used by the Flemish authorities over 20 years to determine the nautical bed for the port of Zeebrugge.

The Navitracker system can be operated by a computer controlled winch to tow it through the mud (horizontal mode). The Navitracker is equipped with the following sensors:

- The Gamma ray density sensor, mounted on a fork-like tow fish, gives density information.
- The depth sensor gives information of the depth of the sensor.
- The position of the fish is calculated out of the length of the winch cable. Together with the position of the tow fish, following the density level, a dual frequency echo sounder is used to

map the hard bottom and the top of the mud. With a speed of 2 to 3 knots, large areas can be covered.

For these measurements the Navitracker was used in a vertical profiling mode, with the probe in vertical position in order to penetrate the soft bottom. The vertical density profiler is used to measure density in thick mud layers with high densities.

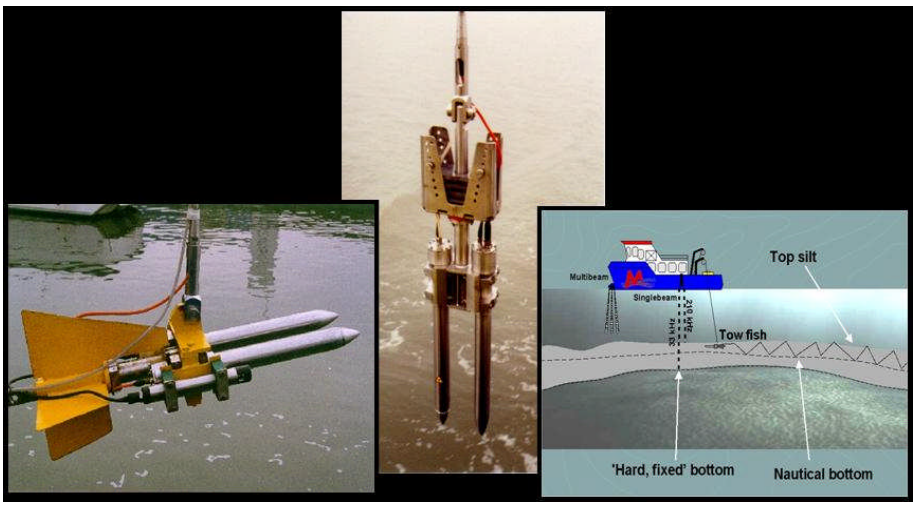

Figure 3-1: Navitracker

The Navitracker was calibrated in the laboratory for measuring high densities, formed by very dense water-mud mixtures. For this reason the Navitracker did not detect subtle variations in density caused by changes in salinity. The density deviated from 1.000 ton/m³ only in the presence of a high concentration of sediments.

The Navitracker has a sampling frequency of 10 measurements per second.

As a reference situation the empty dock will be used at the design depth. The design depths for the different zones are shown in Table 3-2. The different zones are described in §4.1.

Table 3-2: Reference Situation Density Measurements (t_{0d})

Zone	***Design Depth (mTAW)***
Central trench	-19
Berthing zones and transition zones to central trench	-17
Sill	-13.5
Transition sill to navigation channel	Not applicable

The resulting profiles were processed in a Matlab environment and visualized in Matlab and ESRI ArcGIS. Equal density layers were computed. Volume and density information was used to calculate masses of silt. All masses are given in ton of dry solids (TDS) characterized by a density of 2.65 kg/dm³. The water-bed interface is defined as the layer with a density of 1.03 kg/dm³.

In this measurement campaign, Navitracker density measurements have been performed on 24 January and 22 February 2008.

3.3. Maintenance Dredging Data

All maintenance dredging (except sweep beam) activities in Deurganckdok were collected in the BIS-system. This system gives a standardised output per week, that states the weight, volume and V'[1] removed/dumped in every 5*5m grid cell in the area. In case the density of the dredged sediment in the hopper bin is larger or equal to 1.6 kg/dm³, V' is equal to the volume in the bin. In case the density is smaller than 1.6 kg/dm³, V' is equal to the reduced volume which is defined as the volume the dredged sediment would have in case the density would be equal to 2 kg/dm³ (AWZ 2000). These dredged volumes are important to have an overall view on the sediment balance. Maintenance dredging occurred on in the periods 28 January – 17 February, 18-24 February and 3-6 March 2008..

The available data on sweep beam activity is not collected in the BIS-system. However the mode of operation of the sweep beam is explained:

- On the sill (zone 1 & 2): the sediment is swept into the Lower Sea Scheldt
- Inside the dock: the sweep beam sweeps the berthing zones next to the quay walls and moves sediment into the central trench

Therefore an overview is given of where and when sweep beam dredger was working in Deurganckdok (DGD) or on the sill of Deurganckdok (sill DGD).

Table 3-3: Sweep beam Maintenance dredging activities in Deurganckdok and on the sill of Deurganckdok between January and March 2008 (source: Afdeling Maritieme Toegang)

From	***Till***	***Duration (days)***	***Location***
7/01/2008	7/01/2008	1	Sill DGD
11/01/2008	11/01/2008	1	Sill DGD + commercial quays
14/01/2008	16/01/2008	3	Sill DGD
21/01/2008	23/01/2008	3	Sill DGD + DGD
28/01/2008	28/01/2008	1	Sill DGD
30/01/2008	30/01/2008	1	Sill DGD
1/02/2008	1/02/2008	1	Sill DGD
4/02/2008	5/02/2008	2	Sill DGD + northern commercial quays
3/03/2008	3/03/2008	1	Sill DGD

An overview of the total dredged mass in all zones (BIS data) is provided in APPENDIX K. The sweep beam tracks are shown in APPENDIX D. The loggings of the sweep beam tracks show the position and depth of the rake. From the up-down position of the rake and the ship's direction, it is possible to identify whether the ship is sweeping sediment into the Scheldt or not.

3.4. Capital Dredging Data

In February 2007, the 3rd phase of the capital dredging works was initiated. Topographic measurements on a regular grid were supplied by the contractor in order to follow up the capital dredging progress. For the period 01/01/2008 till 31/03/2008, progress data is only available for 8 February 2008 (see APPENDIX E; note that the design depth of the first half of the dock is presented and not the actual bathymetry). The latter is the date of completion of the capital dredging works.

[1] V' = Reduced Volume

The data allow studying the progress of the dredging works. In reference to 14 February 2007, i.e. before capital dredging started, the volume of removed sediment is calculated. In order to calculate the tidal prism in §5.2, the decadal tide data at Liefkenshoek was used, which resulted in a yearly averaged high and low tide level of 5.19 and 0.05 m TAW respectively.

4. SEDIMENT BALANCE ANALYSES

4.1. Project Area: (Sub)Zones and Sections

To calculate volumes and masses for the sediment balance of Deurganckdok it is necessary to subdivide it into 5 zones:

- Zone 1: Between the sill and the navigation channel in the Lower Sea Scheldt.
- Zone 2: Sill at entrance DGD designed at –13.5 m TAW.
- Zone 3: Central trench in DGD with a design depth at –19 m TAW (including slope to –17 m TAW)
- Zone 4: Transition between central trench and berthing zones with a design depth at –17.00 m TAW: on both (North (N) and South (Z)) sides of DGD (55 m wide).
- Zone 5: Berthing zones next to quay walls on both (North (N) and South (Z)) sides of DGD (40 m wide)

Zones 3, 4 and 5 are subdivided into subzones A, B, C, D and E. This is shown in Figure 4-1.

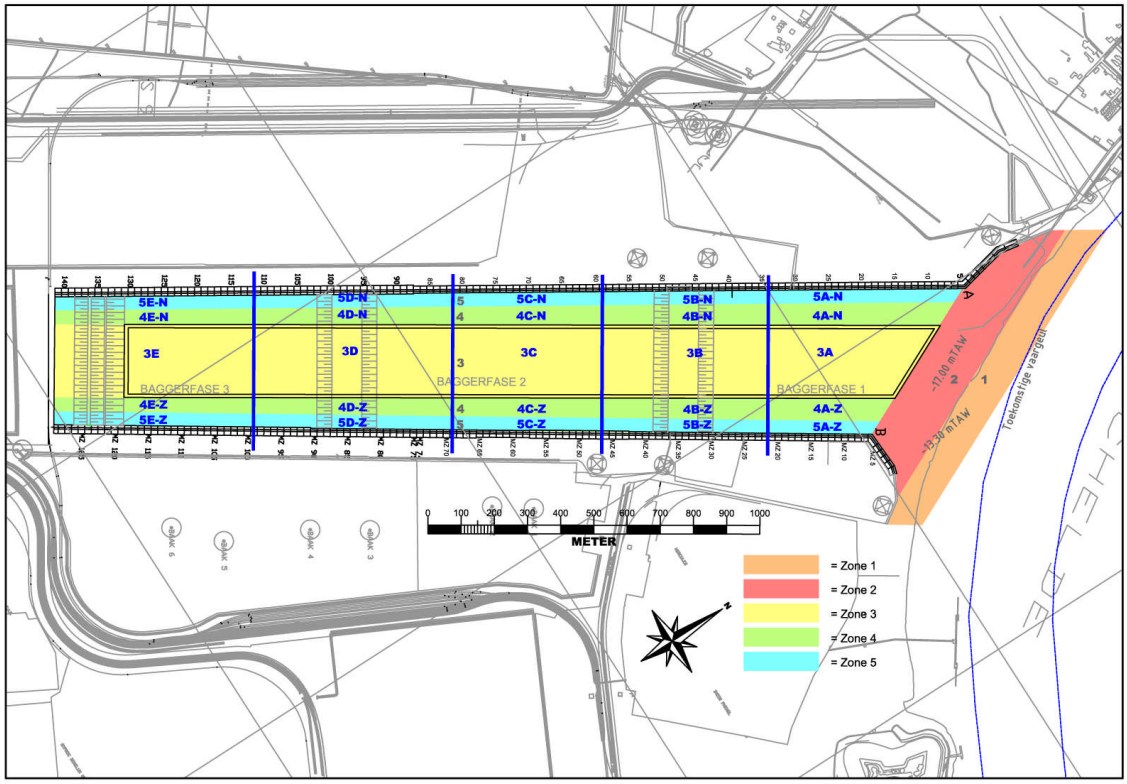

Figure 4-1: Deurganckdok: Zones and Subzones

Sections are defined for this whole area (Figure 4-2):

- D sections are oriented perpendicular to the quay walls inside the dock and parallel to the navigation channel outside the dock (sill and Scheldt). The origin of the sections is taken on the quay wall at the left bank (West side) looking outwards.
- L Sections are oriented along the centerline of the dock and run from the navigation channel towards the inland end of the dock, in anticipation of the realisation of the third phase of Deurganckdok. The origin is situated on the intersection between each L section and section D10.

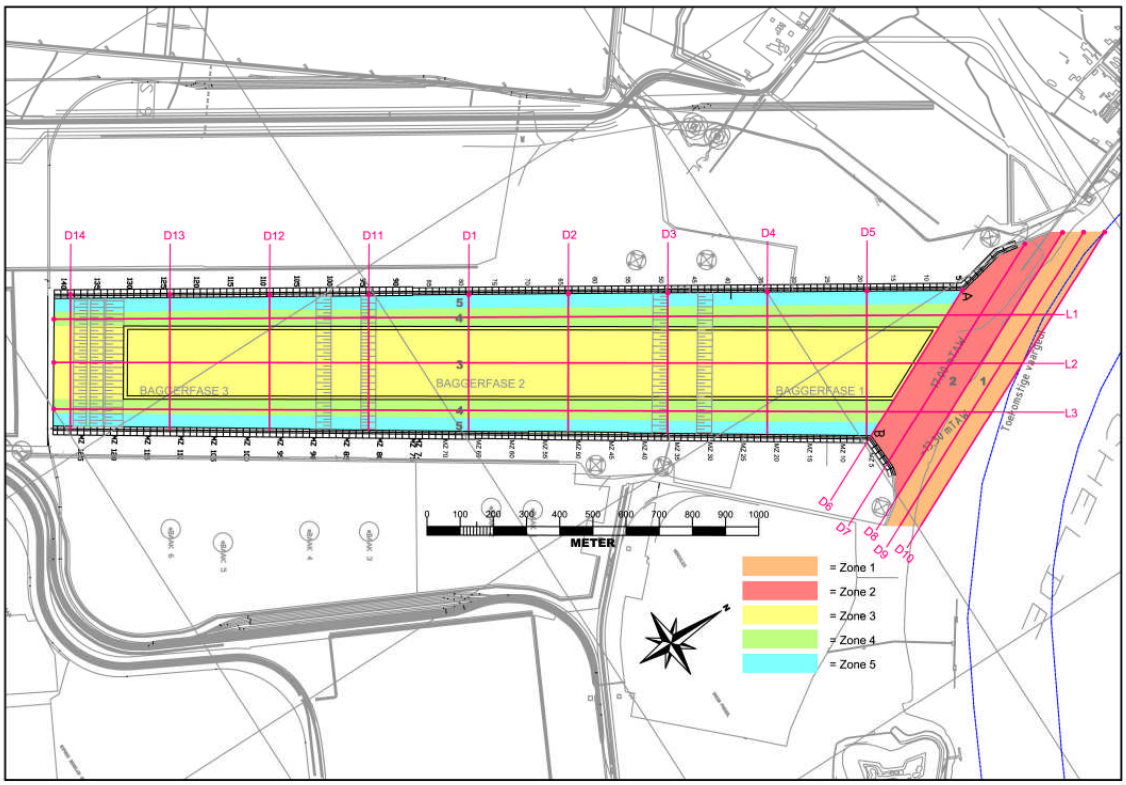

Figure 4-2: Deurganckdok: D and L Sections

The coordinates of these sections are given in Table 4-1.

Table 4-1: Coordinates of Sections [UTM ED50]

Name	***Origin***		***End***	
	Easting	***Northing***	***Easting***	***Northing***
D Sections				
D1	587773	5683253	588123	5683037
D2	587929	5683510	588283	5683290
D3	588084	5683767	588444	5683544
D4	588239	5684023	588604	5683797
D5	588394	5684280	588765	5684051
D6	588542	5684526	588772	5684062
D7	588521	5684761	588864	5684068
D8	588552	5684875	588972	5684027
D9	588585	5684930	589047	5683994
D10	588617	5684984	589081	5684047
D11	587615	5682997	587962	5682783
D12	587459	5682742	587802	5682529
D13	587300	5682487	587642	5682276
D14	587143	5682232	587482	5682023
L Sections				
L1	588748	5684720	587180	5682151
L2	588825	5684565	587290	5682082
L3	588901	5684410	587409	5682007

4.2. Depth of the water-bed interface (210 kC)

This is shown as a GIS grid map generated directly from the depth sounding data and is shown in APPENDIX A. An example is shown in Figure 4-3.

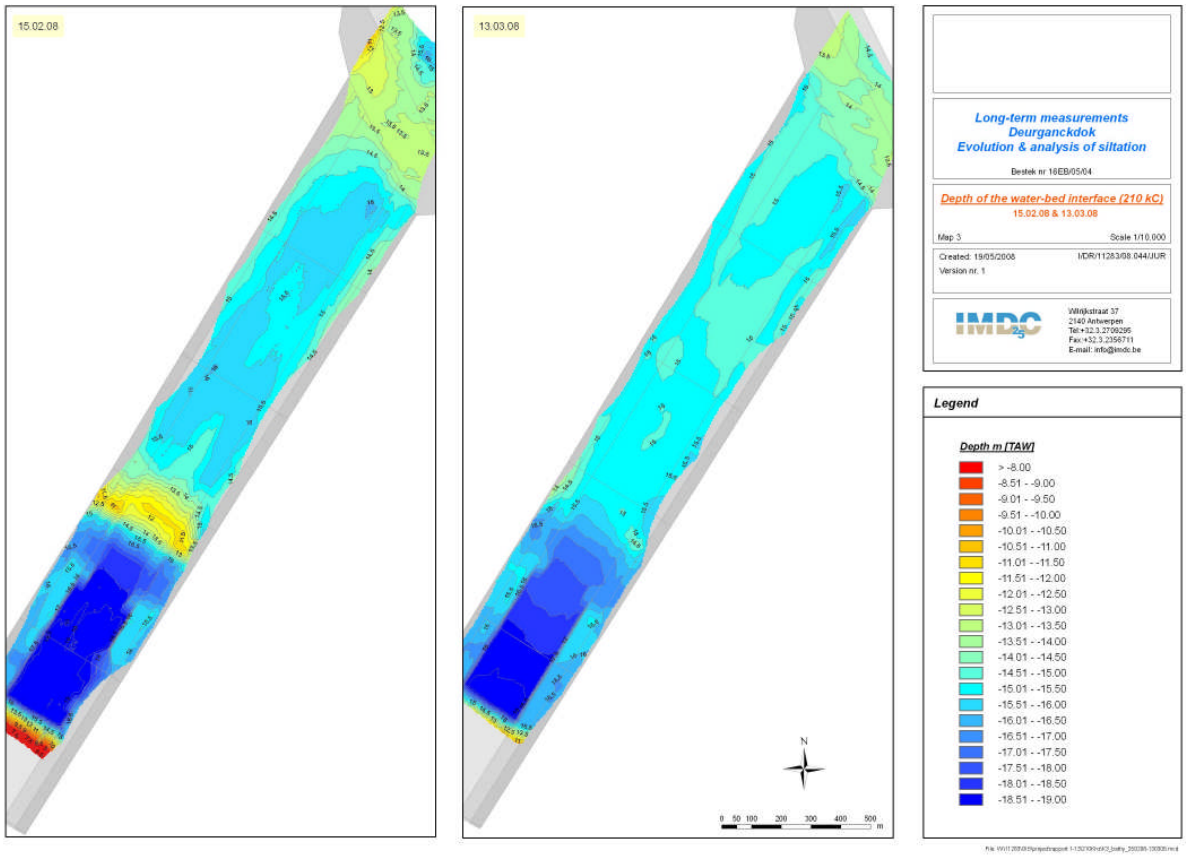

Figure 4-3: Example of a map showing depth of water-bed interface (210 kC) for 25/02/08 and 13/03/08

4.3. Evolution of water-bed interface (210 kC)

GIS grid maps show the difference charts for every depth sounding in relation to the reference situation (t_{0e}) and to the previous depth sounding (right). An example is shown in Figure 4-4.

The difference in depth between subsequent depth soundings for 210 kC measurements is also shown for all predefined sections. Graphs show a colour plot with Time in the X-axis, Distance to origin of section in the Y-axis and the depth of the top layer [m TAW] as a colour plot.

The origin for de the D sections is the northern quay wall. The origin of the L sections is the intersection between the L section with the Scheldt edge of zone 1. An example for sections is shown in Figure 4-5. The description of the sections is given in § 4.1.

Maps and graphs are shown in APPENDIX B.

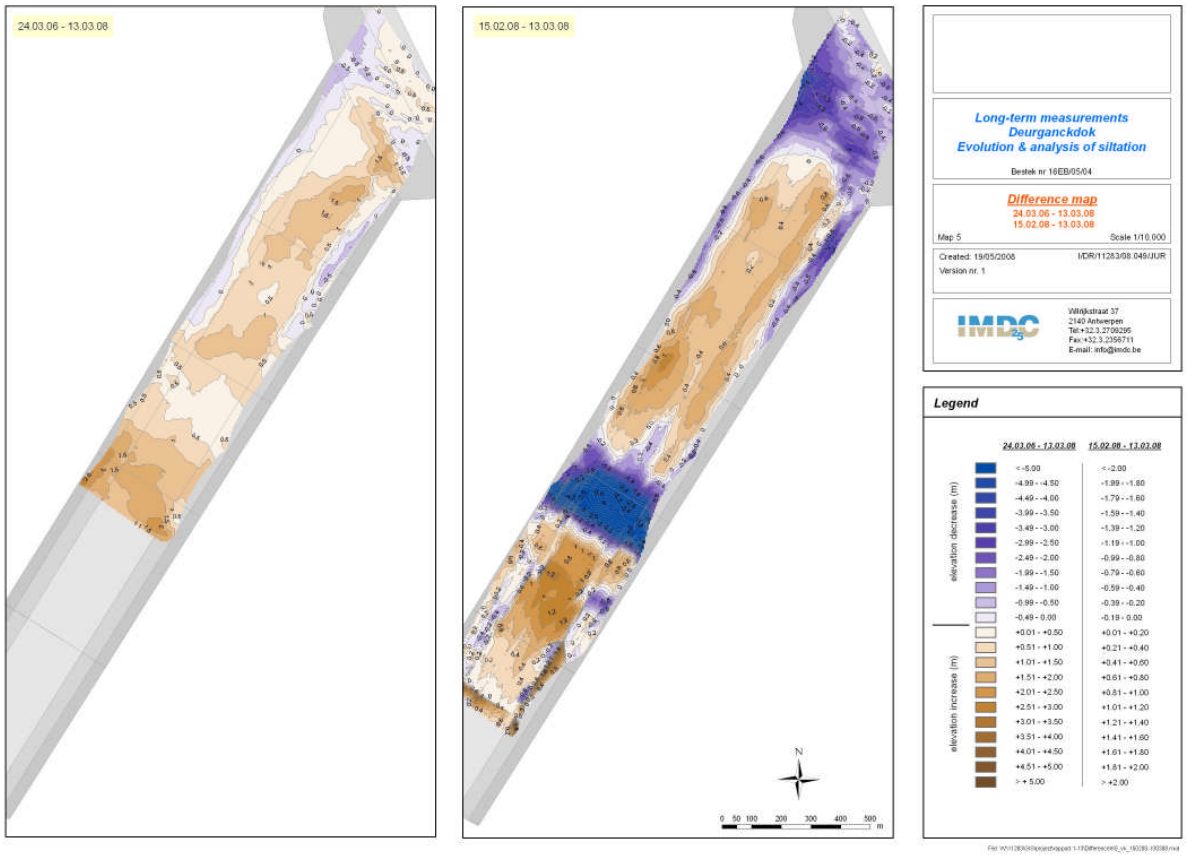

Figure 4-4: Difference charts of the depth sounding on 13/03/08: in reference to t_{0e} (left), and to the previous measurement (right) on 15/02/08

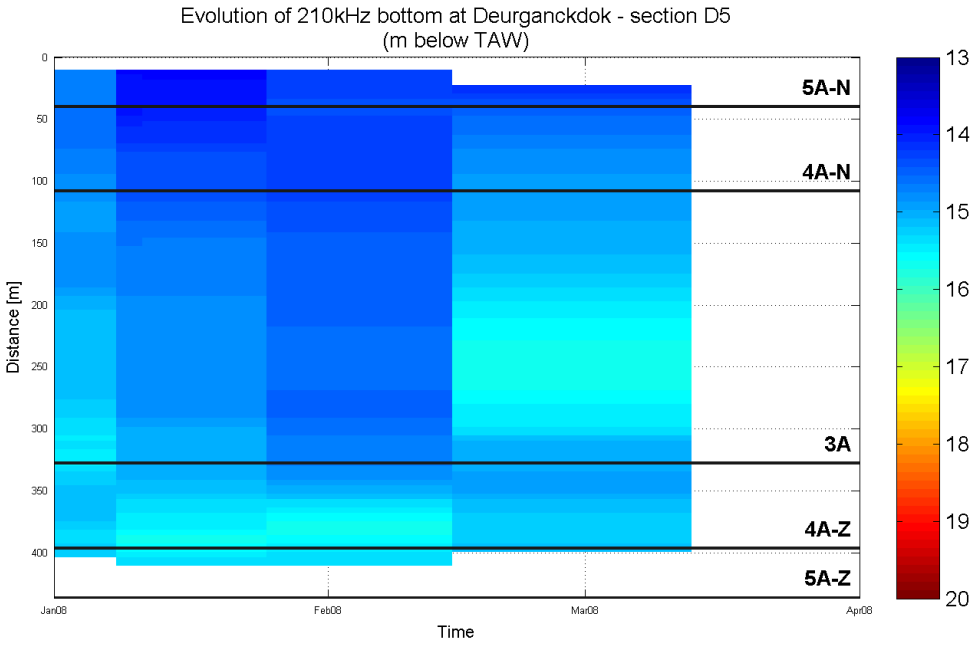

Figure 4-5: Graph of Evolution of the water-bed interface (210 kC) for section D5

4.4. Volumetric siltation rates [cm/day] in different zones and sections

A table with monthly average siltation rates for all (sub)zones is also given in APPENDIX C.

Graphs in APPENDIX C show two parameters:

- Average siltation rates [cm/day]: The average siltation rate is the difference in the depth of the water-bed interface and is calculated only for those zones and subzones that have at least a 50% surface area overlap between two subsequent depth soundings. This is done for all successive depth soundings. For each month an average siltation rate is calculated this way. It is shown in the plots as a bar and is positive for sedimentation and negative for erosion or removal.
- Cumulative bed level change [m]: an initial situation (t_0) is used as baseline. Starting from this reference level the evolution of the average bed level elevation is shown for the particular (sub)zone.

Dredging events from the BIS system are marked on each of these graphs. This is computed for all zones, subzones, sections and Deurganckdok as a whole. As an example we show siltation rate and cumulative bed level change for zone 3a in Figure 4-6.

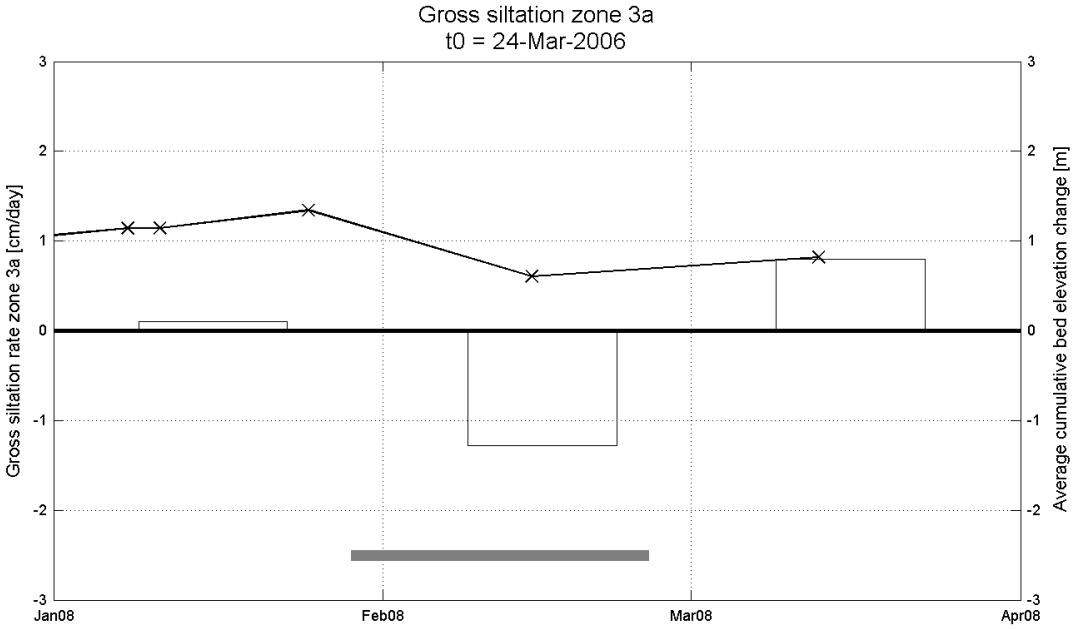

Figure 4-6: Volumetric siltation rate for zone 3a

4.5. Depth of water-bed interface (1.03 kg/dm³) and equal density layers

This analysis is based on density profile measurements from the Navitracker. Maps show the depth of water-bed interface and equal density layers (1.1, 1.2, 1.3 kg/dm³). The elevation of the water-bed interface is here defined as the depth at which the equipment encounters a density of 1.03 kg/dm³. This threshold is chosen since the maximum weight of salt and suspended sediment in the water column is estimated at 30 g/l, corresponding with a bulk density of about 1.03 kg/dm³. When the density passes this value, the equipment is assumed to reach the water-bed interface. The depth of the layers of constant density can be found in APPENDIX F, whereas APPENDIX G

gives the density profiles for the different sections in Deurganckdok. An example for equal density layers in section D3 is given in Figure 4-7. An example of a map is given in Figure 4-8. The description of the sections is given in § 4.1.

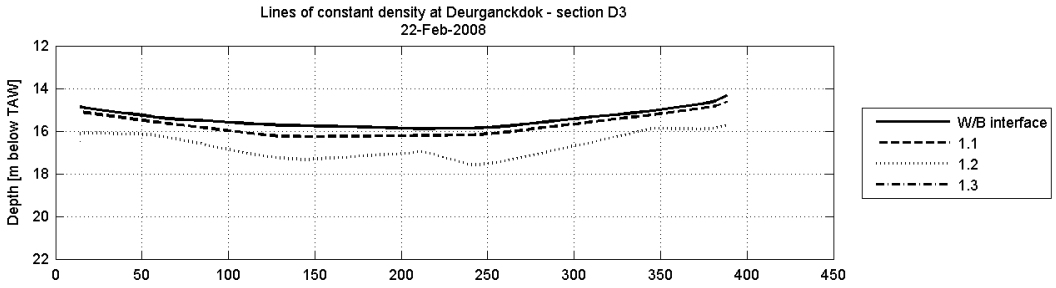

Figure 4-7: Depth of water-bed interface and equal density layers in section D3 on 22 February 2008

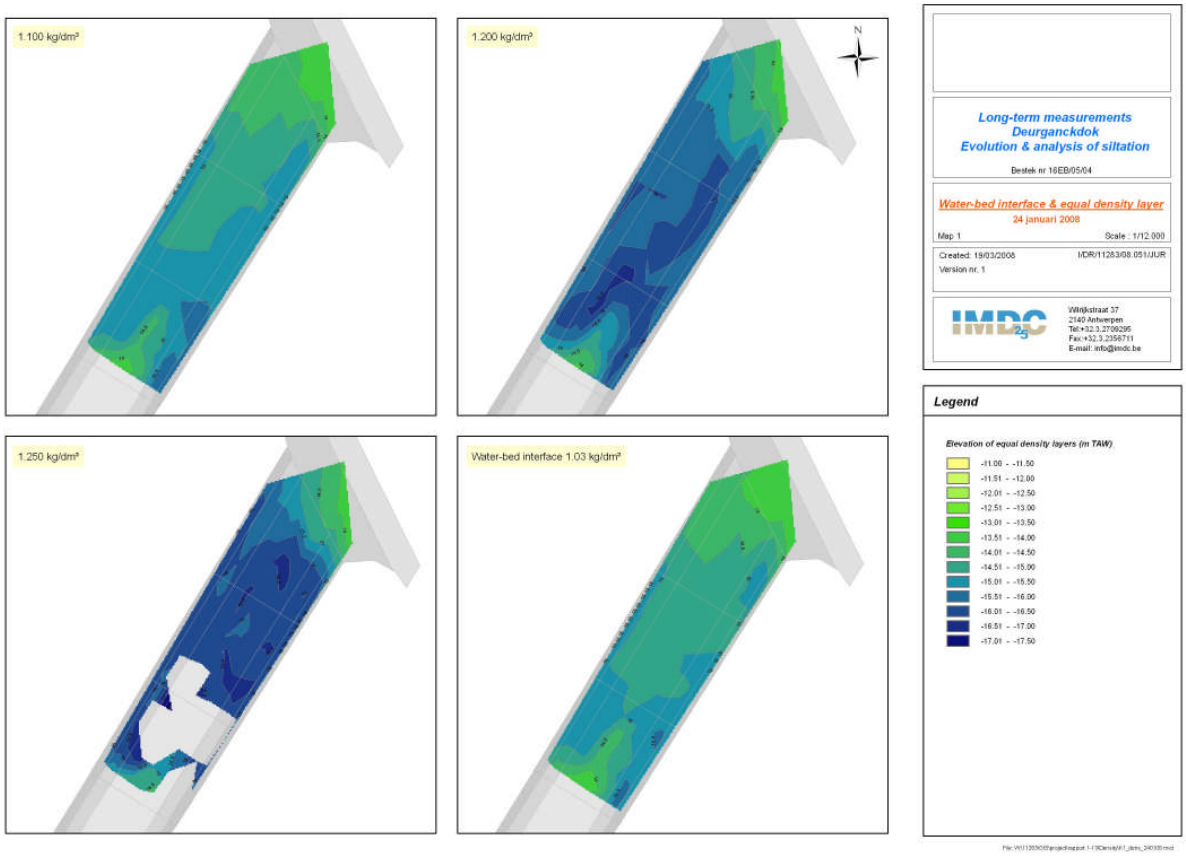

Figure 4-8: Map of the depth of the water-bed interface and equal density layers for 24/01/08

4.6. Evolution of water-bed interface and equal density layers elevation

The evolution of water-bed interface and equal density layers (1.1, 1.2 en 1.3 kg/dm³) are shown for all sections in APPENDIX H. The description of the sections is given in § 4.1. Note that the last measurement of the previous measurement campaign, i.e. 4 December 2007, is added to the present data series in order to have a good view on the density evolution. This makes 3 density measurements in total being used for this comparison. Sections of four different planes of constant

density are determined. These planes are determined by mapping the depths at which the specified densities have been encountered. For every measurement campaign the elevation of these planes across the sections has been plotted. An example is shown in Figure 4-9

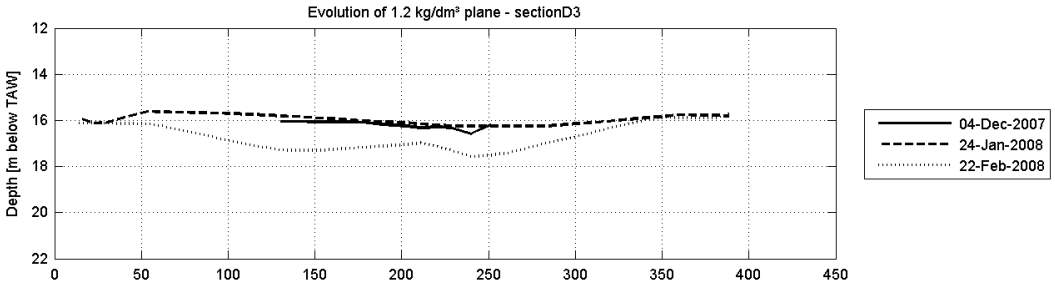

Figure 4-9: Graph of the evolution of 1.2 kg/dm³ plane in section D3

4.7. Measured mass maps

The measured mass in [TDS/m²] is calculated and visualized in maps for every measurement in reference to the empty dock at design depth (reference situation t_{0d}) (see §3.2). Every map is based on a density measurement.

These maps are shown in APPENDIX I.

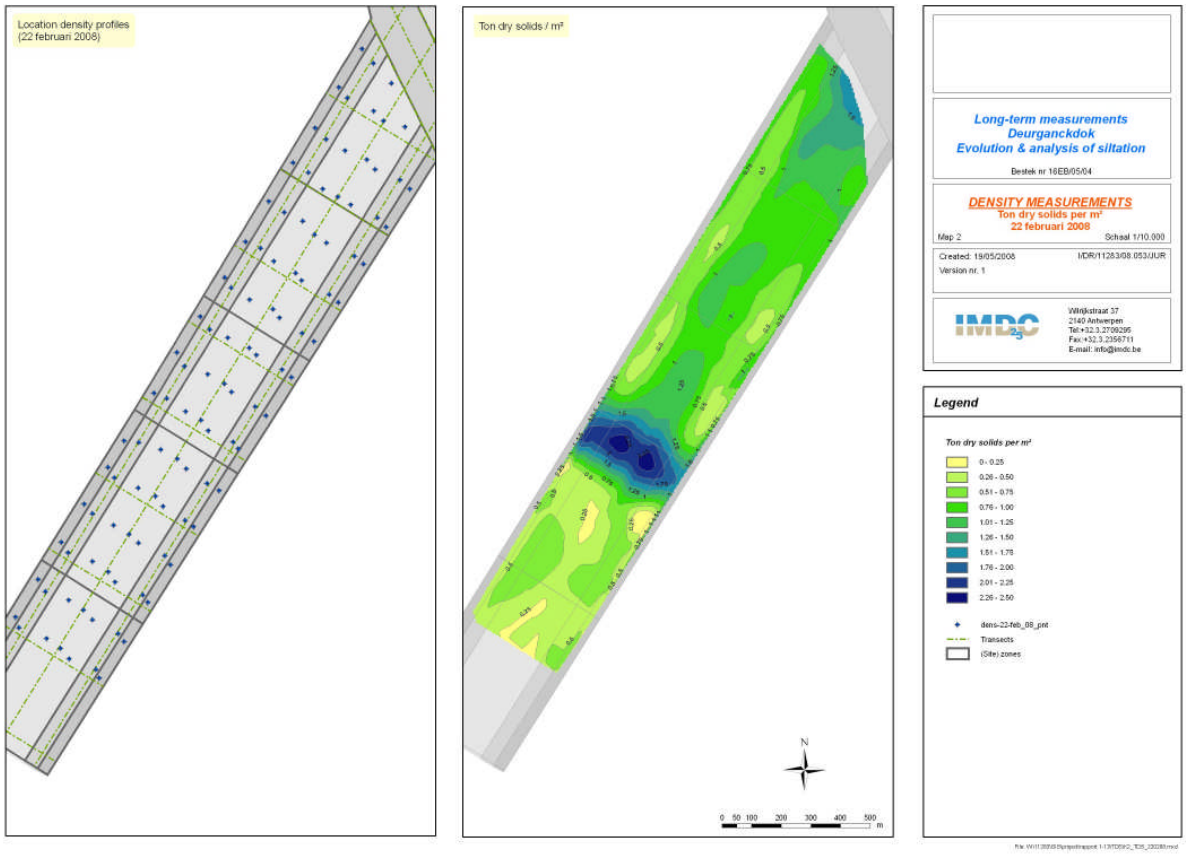

Figure 4-10: Map showing the location of the density profiles (left) and the calculation of TDS (right) on 22/02/08

4.8. Average net mass evolution

The average net mass growth [TDS/m²] in all zones and subzones is based on density profile measurements (measured sediment mass). The actual sediment mass present in the dock and measured by density profiling does not take the removed dredged material into account. The mass removed by dredging can be computed from BIS data (dredged material mass). Only the sediment dredged on locations for which the mass present in the bed could be measured is taken into account.

By adding measured mass to dredged material mass, the total accumulated mass and hence the growth can be shown (see Figure 4-11). In case this *total mass* can be computed for the complete dock (or a zone) for two subsequent measurements, an estimation of the net sediment flux into the dock (or zone) during the intermediate period is given by the difference of both total mass values. The net sediment flux into an area can also be defined as the net mass growth (kg/m² or Ton Dry Solids/m²). Division of the net mass growth of a zone by the number of days in between measurements leads to the averaged net mass growth rate. Note that the last measurement of the previous measurement campaign, i.e. 4 December 2007, is added to the present data series in order to have a good view on the net mass evolution.

Averaged net mass growth rate [kg/m²/day] is computed for each zone and subzone and is shown in APPENDIX J. An example is shown for zone 3B in Figure 4-12.

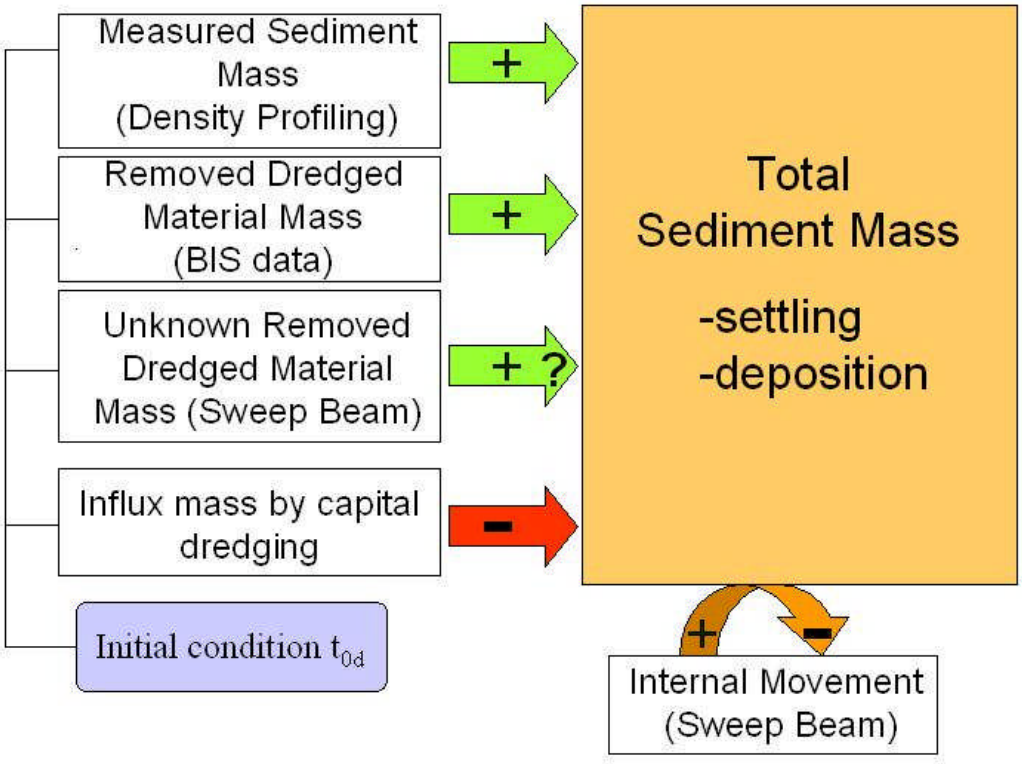

Figure 4-11: Flow chart with different elements contributing to total sediment mass for (sub)zones and total area

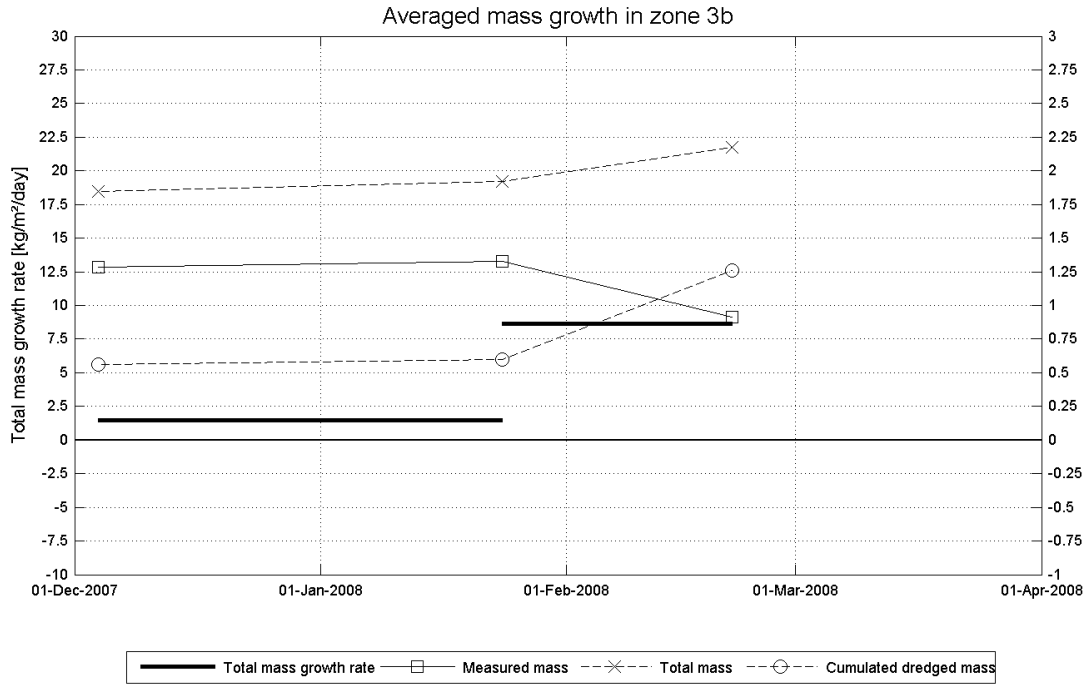

Figure 4-12: Example of averaged mass growth and mass evolution for subzone 3B

Clearly, the sediment mass balance is incomplete because sediment fluxes cannot be derived from the sweep beam data (of which no mass or volume information is available). Internal movements of sediment by the sweep beam (berthing zones to central trench) and removal of sediments from the sill into the Lower Sea Scheldt definitely influence the mass balance for (sub)zones and the total dock.

A table in APPENDIX J gives an overview for all zones and subzones for the following parameters, and this only if data is available for at least 50 % of this (sub)zone:

- Measured Sediment mass [TDS/m²]
- Dredged Material mass (absolute) [TDS]
- Total Sediment mass [TDS/m²]
- Growth rate [kg/m²/day]]
- Total area [ha]
- Covered area [ha]: area covered by density profiles
- Percent of zone covered [%]

4.9. Capital dredging works

Capital dredging data is used to compute the time evolution of the volume of dredged sediment. The volumetric change has been calculated in reference to 14 February 2007.

To compute the tidal prism, it is necessary to have an idea about the total dock volume available for water storage during high and low tide. Therefore, the decadal tide data at Liefkenshoek was used and resulted in a yearly averaged high and low tide level of 5.19 and 0.05 m TAW respectively (AMT, 2003). In the operational part of the Deurganckdok (see Figure 4-13), the

volume of exchanged water remains constant, and does not contribute to any change in tidal prism, during the capital dredging works. For the remainder of the dock, topographic measurements were applied for the necessary calculations. An example of such a data set is shown in Figure 4-14.

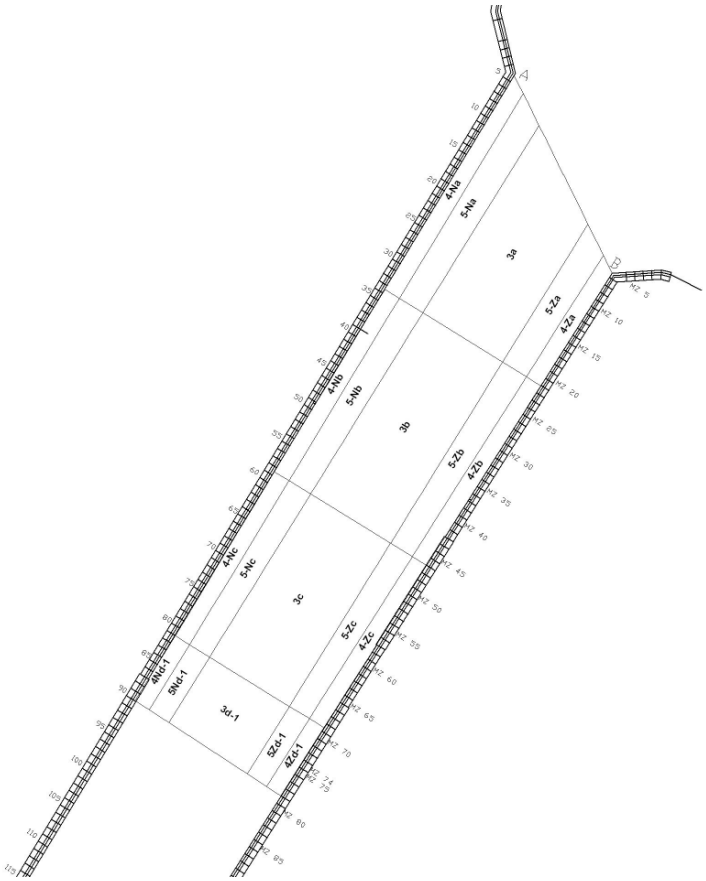

Figure 4-13: Operational part of Deurganckdok at the start of the 3rd phase of capital dredging works (Feb. 2007)

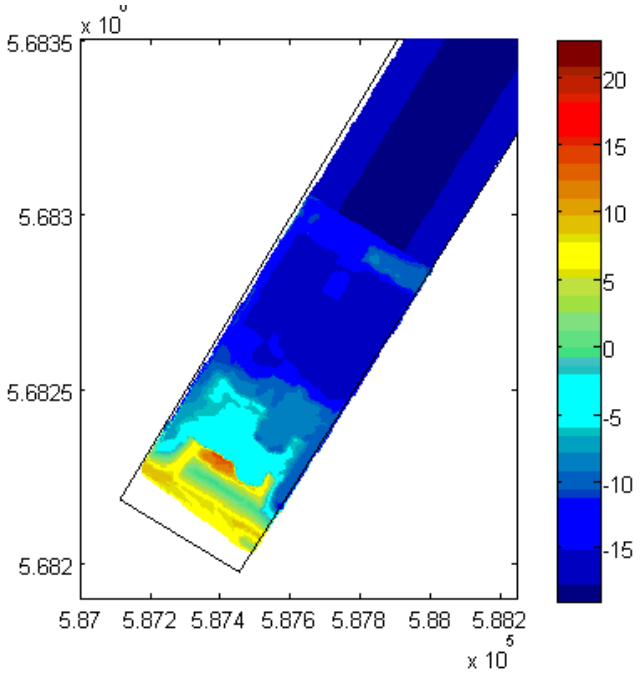

Figure 4-14: Depth of capital dredging (and design depth) on 16/10/2007

5. PRELIMINARY ANALYSIS OF THE DATA

5.1. Volumetric analysis

Depth sounding data is processed to show the evolution of the average sediment volume per unit of surface, i.e. the average evolution of bed level as detected by a 210 kHz sounder. If more than 50% of the area of a (sub)zone is covered, an average siltation rate is calculated. For the period of January - March 2008, depth soundings were performed on 8, 11 and 25 January, 15 February and 13 March. During these measurements, an adequate coverage was obtained during depth soundings for subzones A-C for zones 2, 3 and 4.

The bathymetric measurements in APPENDIX A and the corresponding bathymetric difference maps in APPENDIX B show that the bed interface moves to decreasing depths in the central trench between 11 and 25 January 2008. This bed level increase is a combination of natural siltation and sediment originating from the quays by sweepbeam dredging.

Maintenance dredging between 25 January and 15 February occurred in zones 3A-C, resulting in a bed decrease of approximately 50-80 cm. The sediment plug in subzone D was further removed in subzones 4 and 5. This plug of sediment formerly operated as barrier between the operational part of the dock and the part under construction, cf. dredging phase 3.

Finally, the leftover of the sediment plug was removed in the first half of March (see Figure 5-1). The top of the local sediment bed was deepened for 5 meters in comparison with the situation in February. Instead, zones 3A, 3B and 3C showed a siltation between 0 and 50 cm. The bed at the sill decreased due to sweepbeam and hopper maintenance dredging.

From the depth sounding data, volumetric siltation rates can be computed. APPENDIX C (showing tables with siltation rates per month and for all cross sections, longitudinal sections and subzones) clearly indicates that siltation rates are relatively small and negative, which is due to the frequently occurring hopper and sweepbeam maintenance dredging operations. The dredging largely affected the calculated siltation rates making it difficult to draw conclusions about the natural siltation.

Figure 5-1: Hopper maintenance dredging trajectories on 3-6 March to remove the sediment plug

Capital dredging started in February 2007 in order to deepen the remainder of Deurganckdok to its design depth (Figure 5-2). Capital dredging was finalised in the first half of February 2008 and the last depth sounding was performed on 8 February. In this respect, Table 5-1 summarizes the time evolution of removed sediment by capital dredging. From the table, it is calculated that around 0.77 million m³ sediment was dredged for the period January - early February 2008.

Table 5-1: Calculated volume removed by capital dredging in reference to 14 February 2007

Date	***Dredged volume from capital dredging works*** **(reference time: 14 Feb. 2007)** ***(10^3 m^3)***
03/04/2007	1571.5
08/05/2007	2392.6
18/06/2007	3229.5
25/07/2007	3658.0
31/07/2007	3574.3
06/08/2007	3720.0
28/08/2007	4261.8
3/09/2007	4396.9
12/09/2007	4525.0
18/09/2007	4564.7
25/09/2007	4724.7
4/10/2007	4843.0
16/10/2007	5087.1
24/10/2007	5276.4
30/10/2007	5383.6
26/11/2007	5325.1
3/12/2007	5548.2
8/02/2008	6313.5

Table 5-2: Calculated tidal prism during capital dredging operations at Deurganckdok

Date	***Tidal prism (10^3 m^3)***
start 3th phase	3441.4
26/03/2007	4482.7
03/04/2007	4626.4
08/05/2007	4720.8
18/06/2007	4858.1
25/07/2007	4938.7
31/07/2007	4987.1
06/08/2007	5037.5
28/08/2007	5096.1
3/09/2007	4186.4
12/09/2007	5076.7
18/09/2007	5082.3
25/09/2007	5089.0
4/10/2007	5074.8
16/10/2007	5082.1
24/10/2007	5156.5
30/10/2007	5151.5
26/11/2007	5155.6
3/12/2007	5144.7
8/02/2008	5216.4

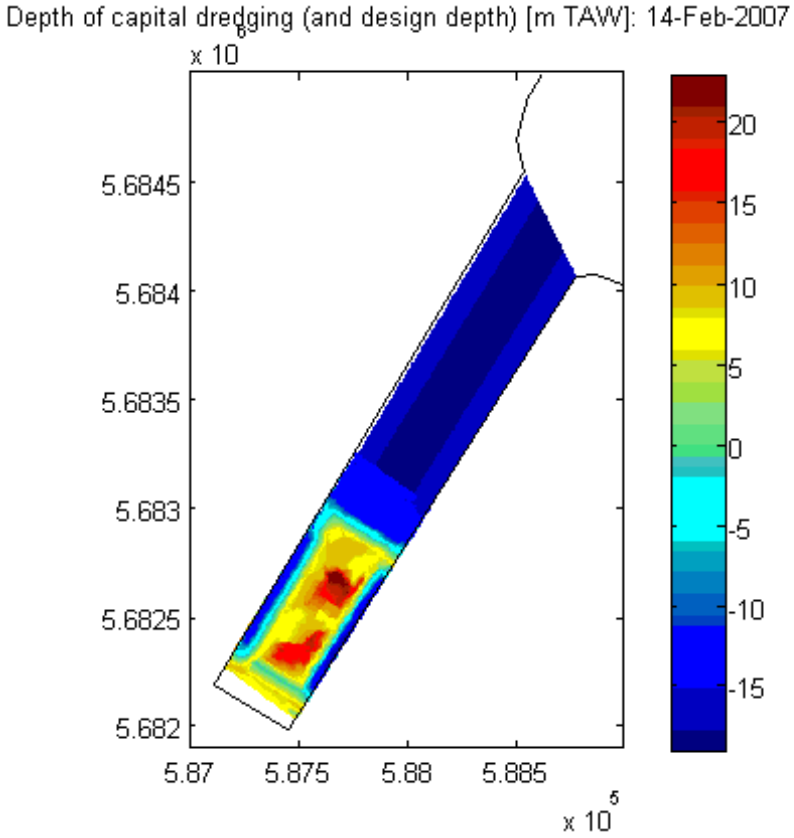

Figure 5-2: Depth before capital dredging works started from the dockside in February 2007 (for the operational part of the dock, the design depth is showed)

5.2. Densimetric analysis

BIS data revealed that hopper maintenance dredging intensity was equally spread in time; only 18-24 February showed a low intensity. In total, 340x10³ TDS was dredged of which 81% originated from zones 3A-D. Other zones only contributed for around 5% or less to the total amount. Remark that this total dredged amount is of the same order of magnitude as for the previous measurement period, i.e. September-December 2008, in which 247x10³ TDS was dredged.

Sweep beam maintenance dredging took place both on the sill and along the commercial berth zones A and B. During this measurement period, the sill has been intensively swept. The northern commercial quays are intensively swept too on the following dates: 11 and 21 January, and 4 February 2008. The southern quays are swept less frequently because siltation is less pronounced at these locations.

Vertical density profiles have been numerically integrated to calculate the mass of dry solids above a reference plane for each zone (i.e. the design depth of Deurganckdok t_{0d} (see §2.1)). This data availability also enables the use of the densimetric dredging data, cf. BIS data, in the mass balance calculations. Total sediment mass is only calculated for locations where both density profile and dredging information are available. Adding up both leads to the total sediment mass as shown in APPENDIX J. Results show a mass growth rate in the central trench (zones 3A, 3B and 3C) in the range of 8.6 to 14.7 kg/m²/day for the period January – February. These numbers are much larger in comparison to those from the measurement period September – December 2008. In the latter period without any dredging activities, total sediment mass in the central trench ranged between 2

and 9 kg/m²/day. This significant difference can be attributed to a combination of the two dredging processes, i.e. hopper and sweepbeam maintenance dredging. Whereas sweepbeam operations result in an artificial influx of sediment in the central trench, the continuous hopper maintenance dredging in this period leads to a lower bed level and, therefore, to a possible more rapid siltation.

Zones 4N-A, 4N-B and 4N-C showed comparable growth rates in the range of 3.5 – 5.1 kg/m²/day for the period January – February 2008. These values are comparable to the growth rates as observed in October-November 2007, i.e. around 4 kg/m²/day. Instead, their southern equivalents were characterised by larger growth rates (6.4 – 14.4 kg/m²/day). The large growth rate of 14.4 kg/m²/day in zone 4Z-A may be due to the hopper dredging; also here the lowering of the bed level possibly results in a rapid siltation.

An overview of the total mass settled over time, for all zones that have been covered for at least 85%, is shown in Table 5-3 and Table 5-4. An exception to this is zone 4Z-A. Here, a coverage of 66% is obtained. From these figures, it is concluded that between mid-January and mid-February about 142x10³ tons of dry solids have settled in zones 3 and 4, subzones A, B and C. This is much larger than the observed 76x10³ and 66x10³ tons of dry solids being obtained for the periods September-October and October-November 2007 respectively.

Subdividing per subzone (Table 5-4), it is concluded that the settled mass in subzones A (nearest to river) is larger than the settled mass in subzone B. This confirms the hypothesis of a gradual decrease in siltation with distance from the Scheldt river. This is somehow contradicted by the larger settled mass in subzone C in comparison to subzone B. This difference is due to a combination of a larger dredged mass and a smaller measured sediment mass decrease in zone 3C compared to zone 3B (see §J.2). As can be concluded from the measured sediment mass plots in APPENDIX I, the measured settled mass in zone 3C is artificially enlarged by the incomplete coverage of this zone on 24 January 2008, which results in a too small sediment mass to be subtracted from the mass obtained for 24 February 2008 (which equals the amount of settled mass).

Table 5-3: Total sediment mass (measured + dredged, in 10³ TDS) in some zones

zone	***24-Jan-08***	***22-Feb-08***
3a	169	211
3b	146	173
3c	124	162
3d		120
4Na	34	41
4Nb	26	29
4Nc	19	23
4Nd		29
4Za	23	33
4Zb	23	29
4Zc	14	20
4Zd		26
5Na	19	
5Nb	14	
5Za	9	
5Zb	14	

Table 5-4: Mass settled per subzone in zones 3 and 4 (measured + dredged, in 10^3 TDS)

subzone	***24-Jan-08 / 22-Feb-08***
A	59
B	36
C	47

6. REFERENCES

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IMDC (2006b) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.1 Through tide measurement SiltProfiler 21/03/2006 Laure Marie (I/RA/11283/06.087/WGO).

IMDC (2006c) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.3 Through tide measurement Sediview spring tide 22/03/2006 Veremans (I/RA/11283/06.110/BDC)

IMDC (2006d) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.4 Through tide measurement Sediview spring tide 27/09/2006 Parel 2 (I/RA/11283/06.119/MSA).

IMDC (2006e) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.6 Salt-Silt distribution & Frame Measurements Deurganckdok 13/3/2006 – 31/05/2006 (I/RA/11283/06.121/MSA).

IMDC (2007a) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.1 Sediment Balance: Three monthly report 1/4/2006 – 30/06/2006 (I/RA/11283/06.113/MSA)

IMDC (2007b) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.2 Sediment Balance: Three monthly report 1/7/2006 – 30/09/2006 (I/RA/11283/06.114/MSA)

IMDC (2007c) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.3 Sediment Balance: Three monthly report 1/10/2006 – 31/12/2006 (I/RA/11283/06.115/MSA)

IMDC (2007d) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.4 Sediment Balance: Three monthly report 1/1/2007 – 31/03/2007 (I/RA/11283/06.116/MSA)

IMDC (2007e) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.5 Annual Sediment Balance (I/RA/11283/06.117/MSA)

IMDC (2007f) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.2 Through tide measurement SiltProfiler 26/09/2006 Stream (I/RA/11283/06.068/MSA)

IMDC (2007g) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.5 Through tide measurement Sediview neap tide (to be scheduled) (I/RA/11283/06.120/MSA)

IMDC (2007h) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.7 Salt-Silt distribution & Frame Measurements Deurganckdok 15/07/2006 – 31/10/2006 (I/RA/11283/06.122/MSA)

IMDC (2007i) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 2.8 Salt-Silt distribution & Frame Measurements Deurganckdok 15/01/2007 – 15/03/2007 (I/RA/11283/06.123/MSA)

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IMDC (2007k) Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 3.2 Boundary conditions: Annual report (I/RA/11283/06.128/MSA)

IMDC (2007g) Uitbreiding studie densiteitsstromingen in de Beneden Zeeschelde in het kader van LTV Meetcampagne naar hooggeconcentreerde slibsuspensies Deelrapport 6.2 Summer Calibration and Final Report (I/RA/11291/06.093/MSA)

IMDC (2007h). Langdurige metingen Deurganckdok: Opvolging en analyse aanslibbing. Deelrapport 1.11 Sediment Balance: Two monthly report 1/7/2007 – 31/08/2007 (I/RA/11283/07.082/MSA).

IMDC (2008). Feasibility study of echo sounding to determine fluid mud density profiles (I/NO/11283/08.001/BOB).

APPENDIX A. DEPTH OF THE WATER-BED INTERFACE (210 KC)

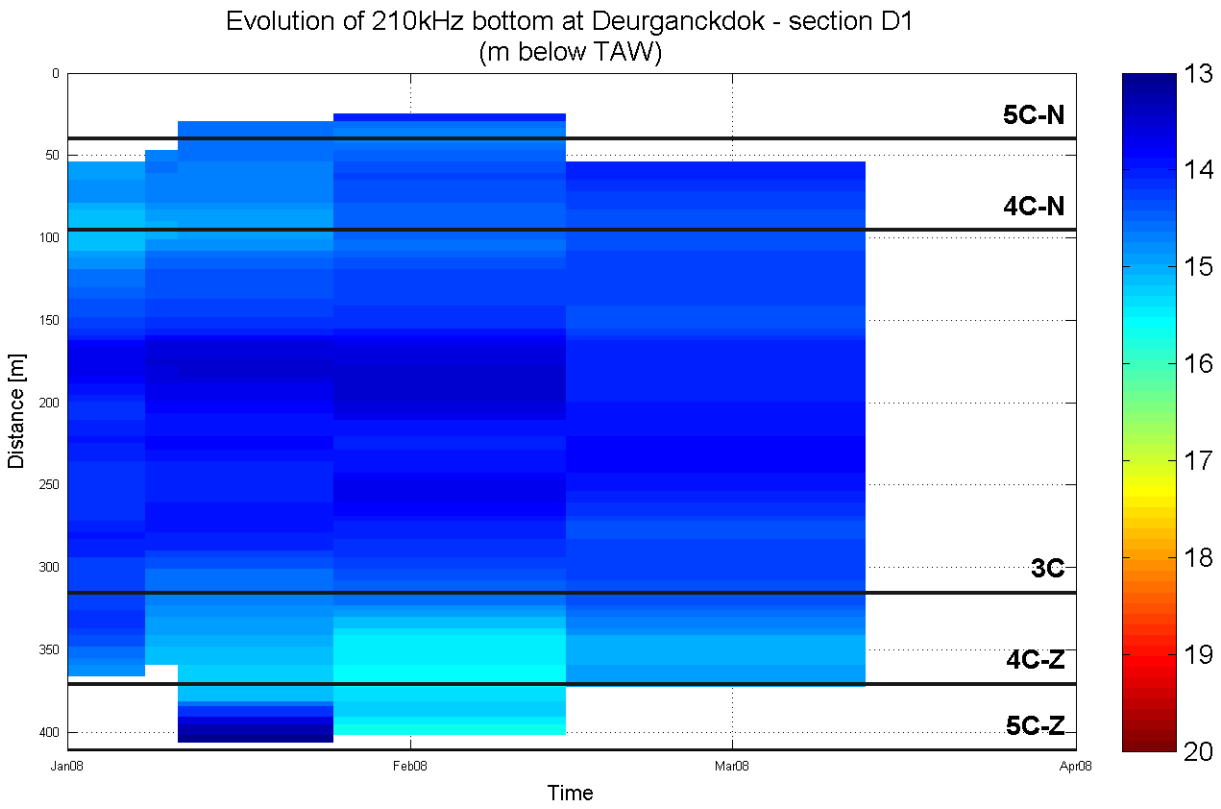
APPENDIX B. EVOLUTION OF DEPTH OF WATER-BED INTERFACE (210 KC)

B.1 Difference maps

B.2 Bed elevation evolution per section

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



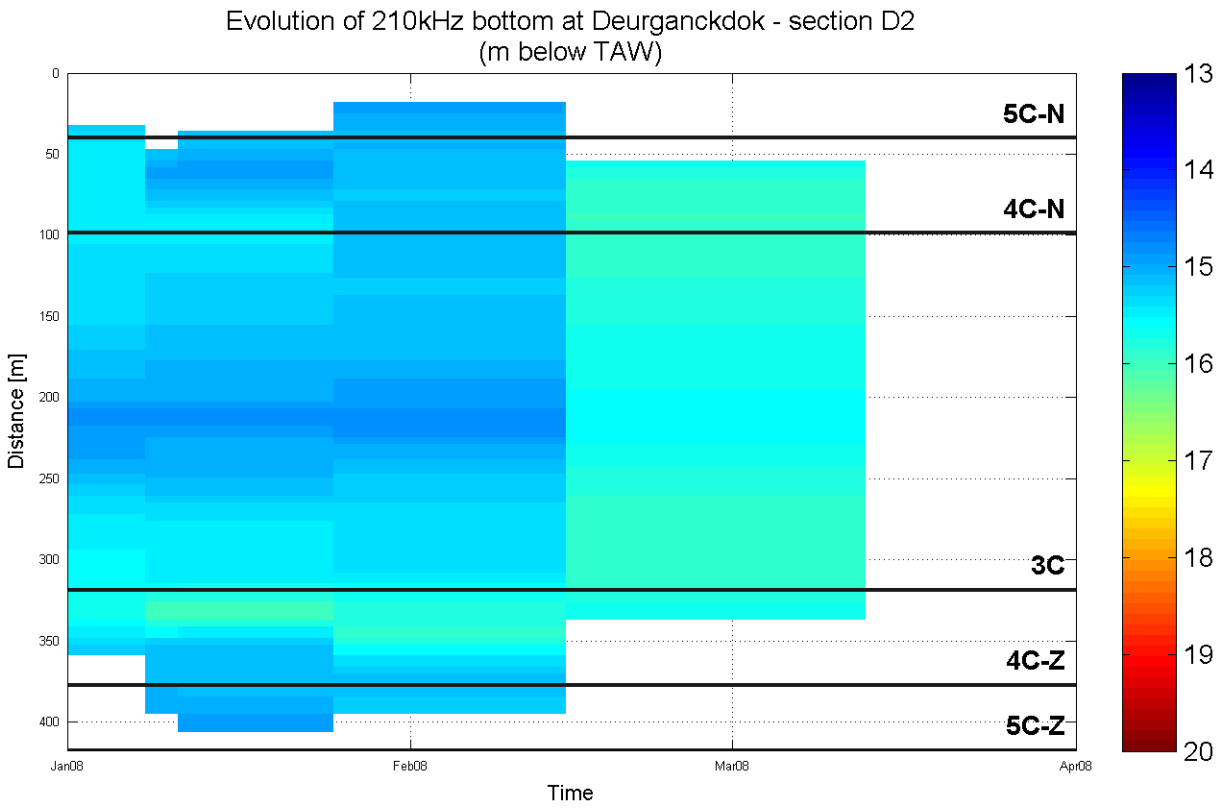
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



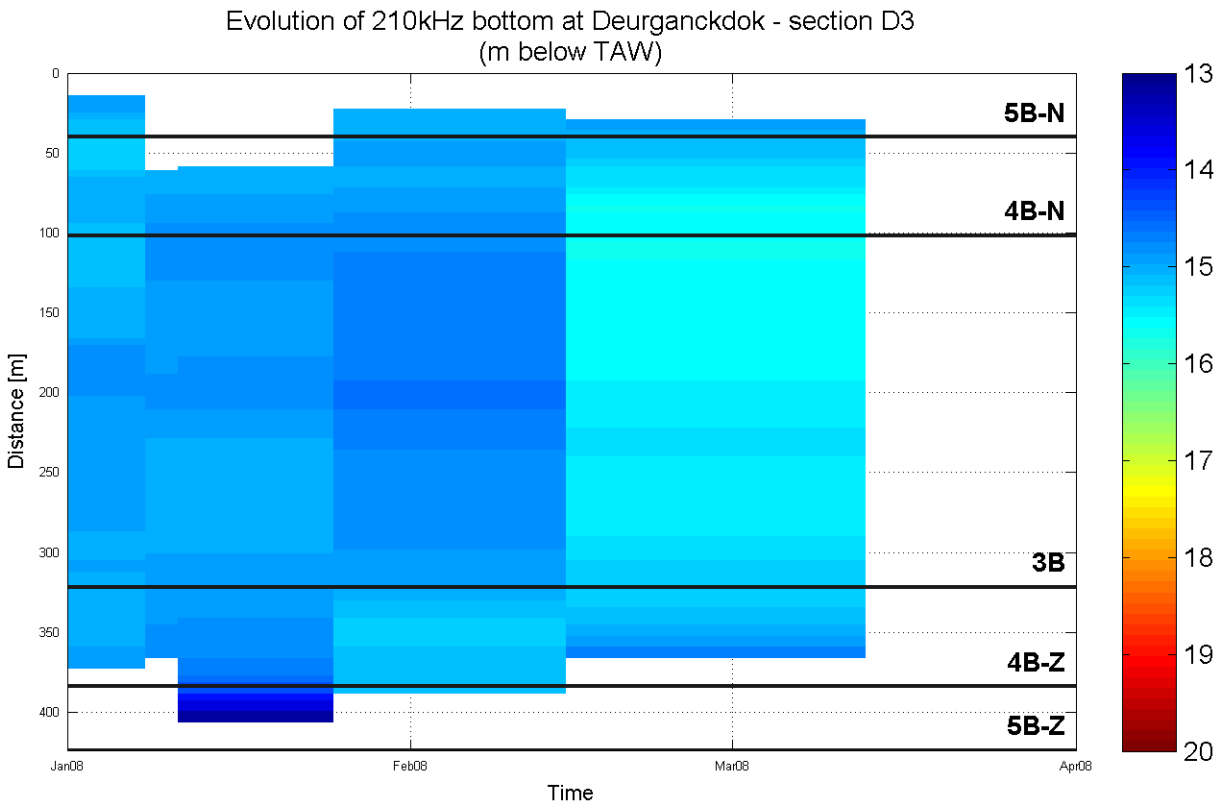
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



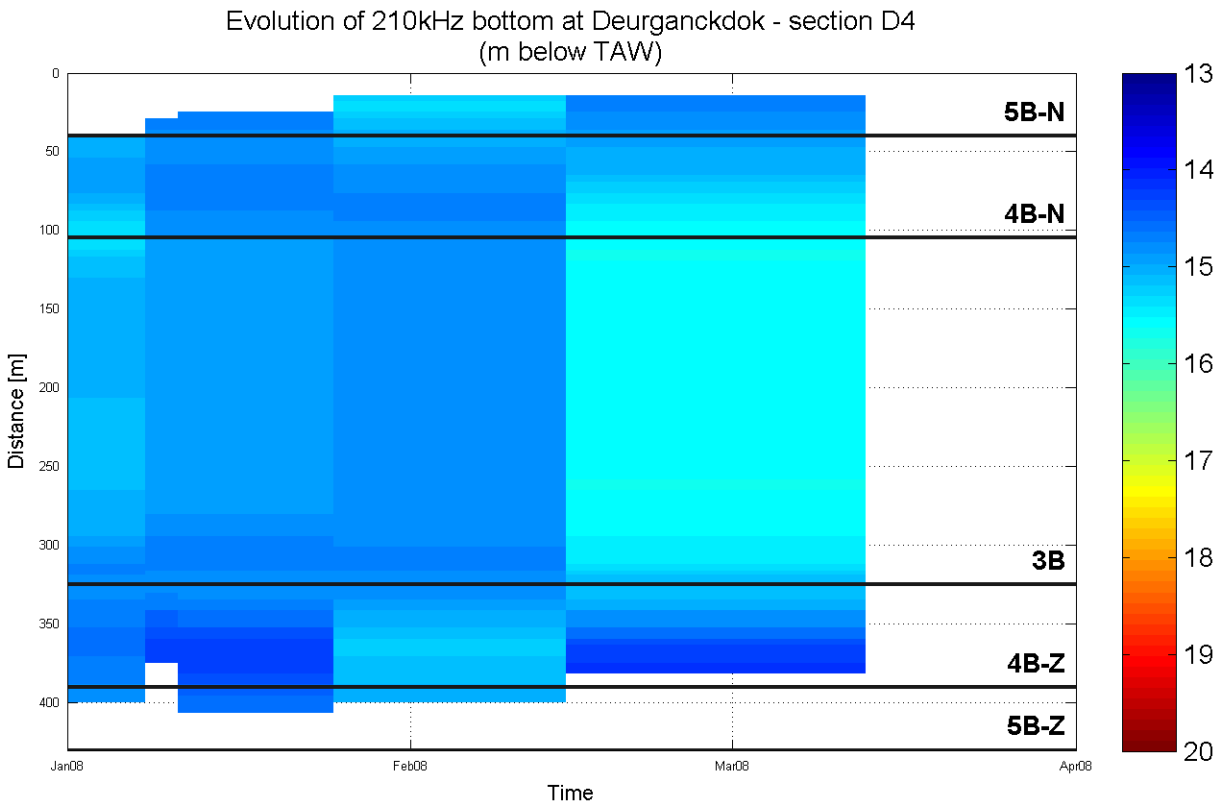
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
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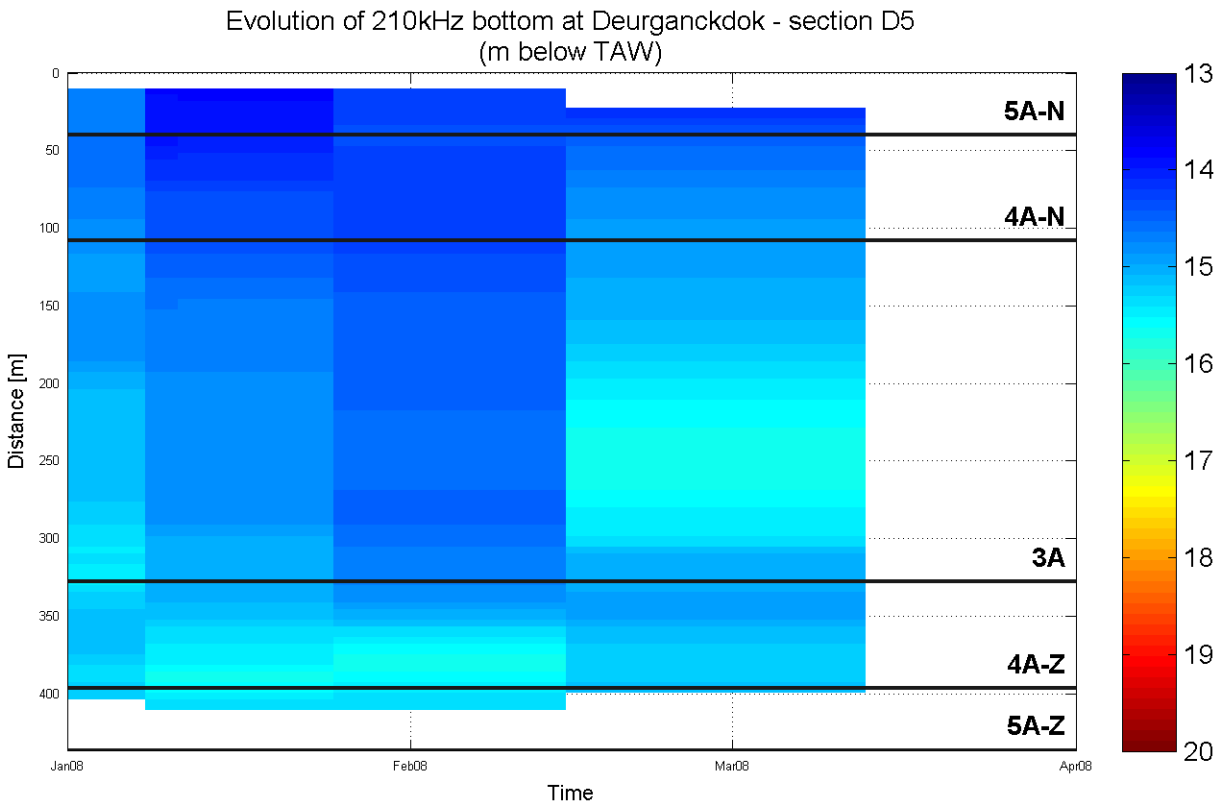


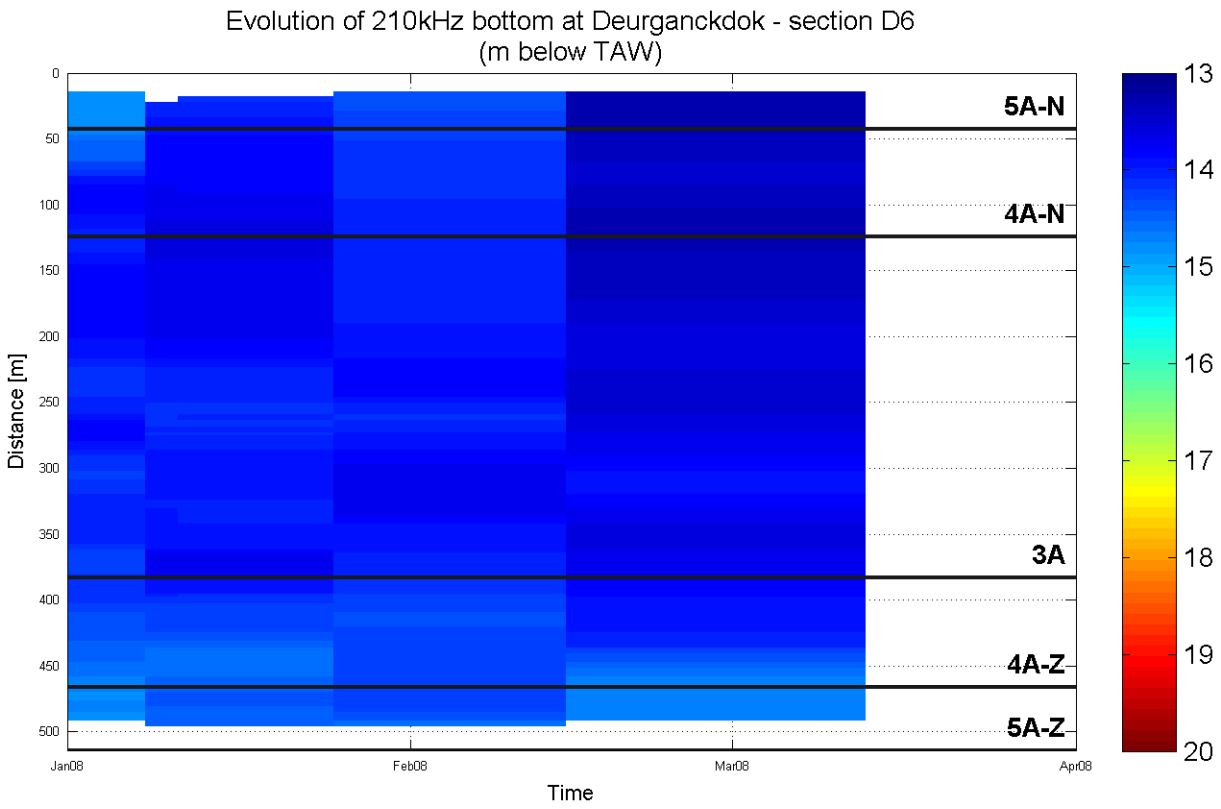
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



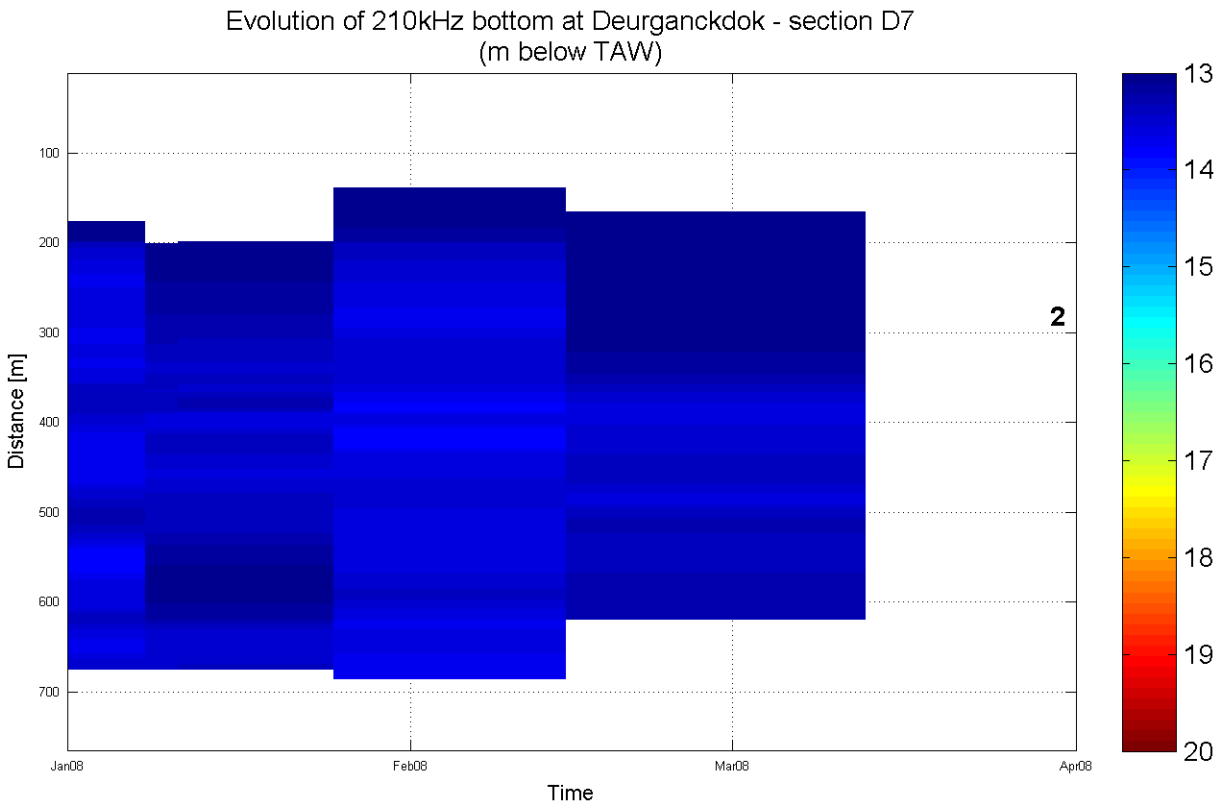
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



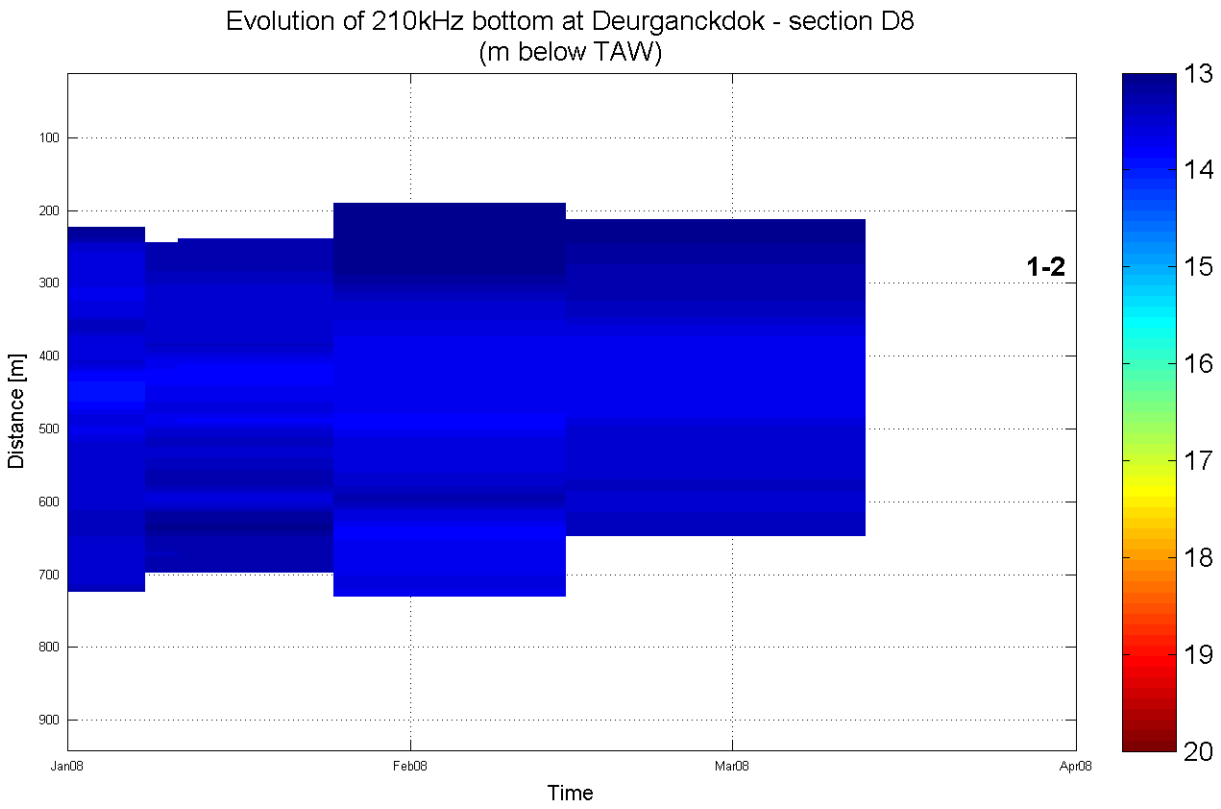
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



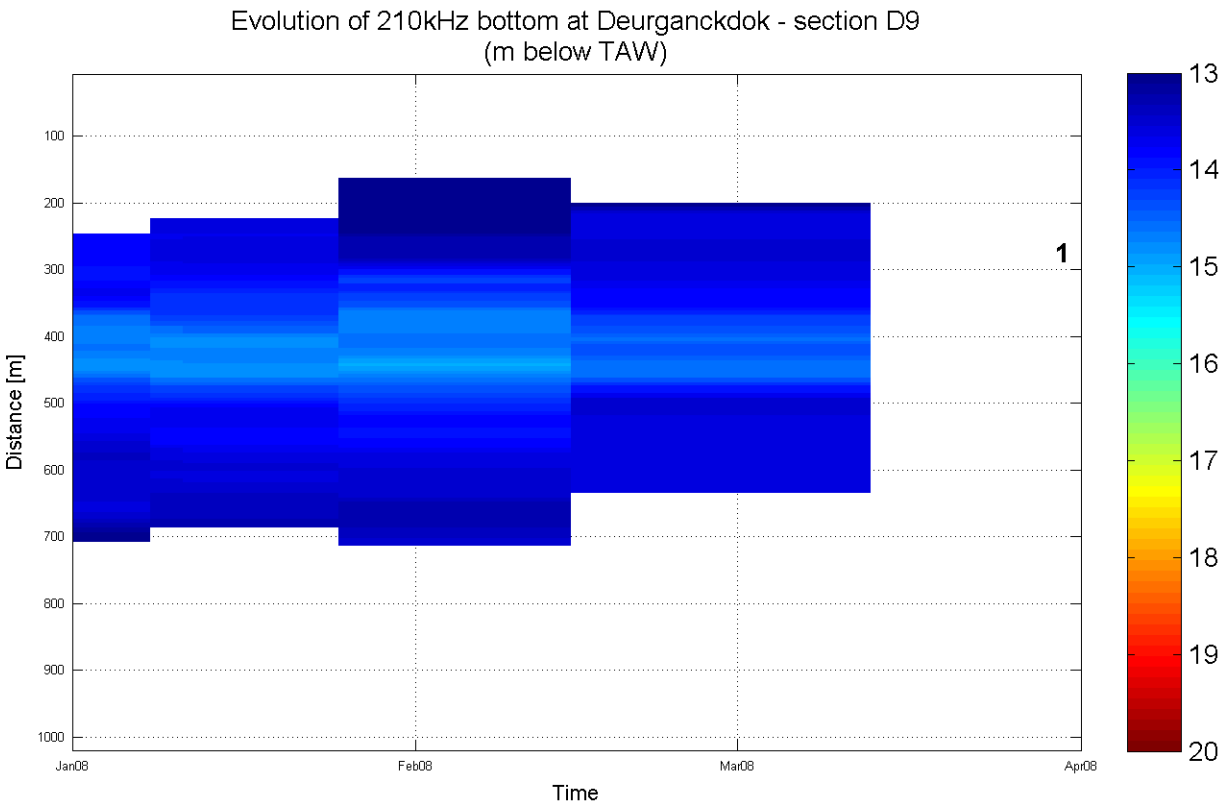
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



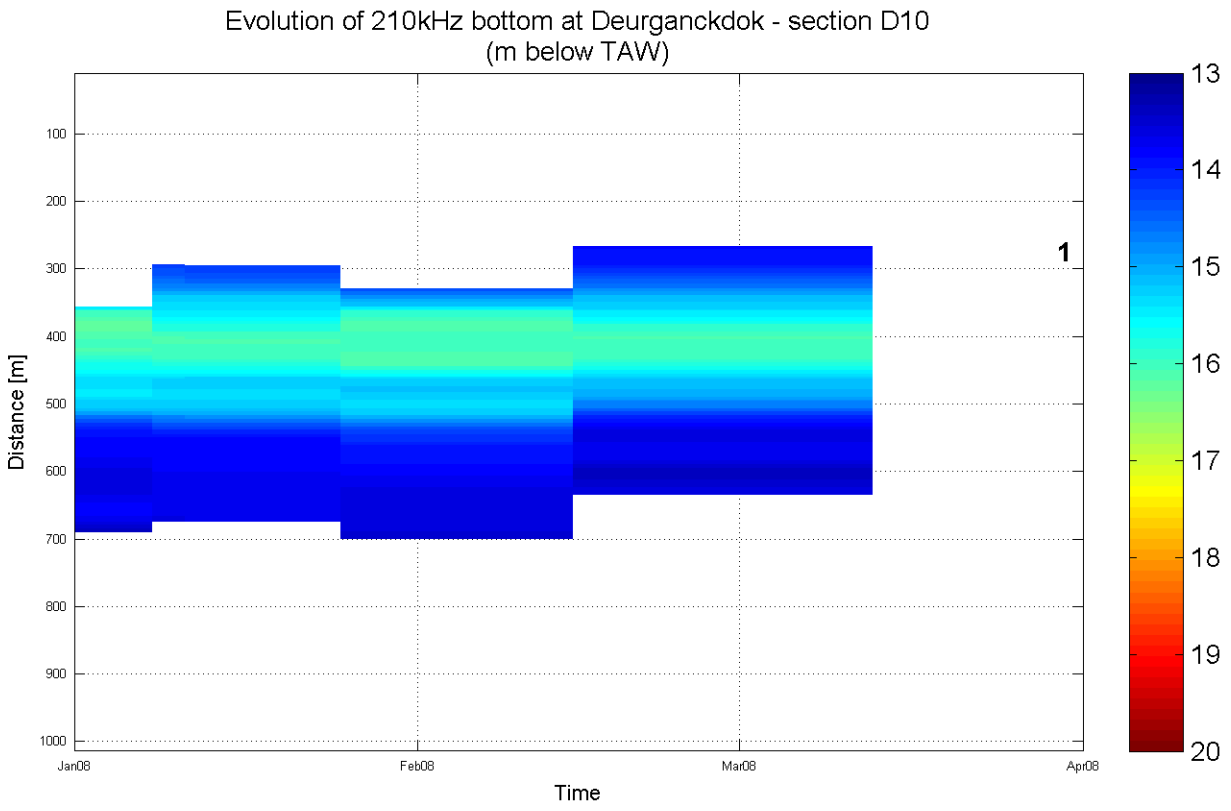
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



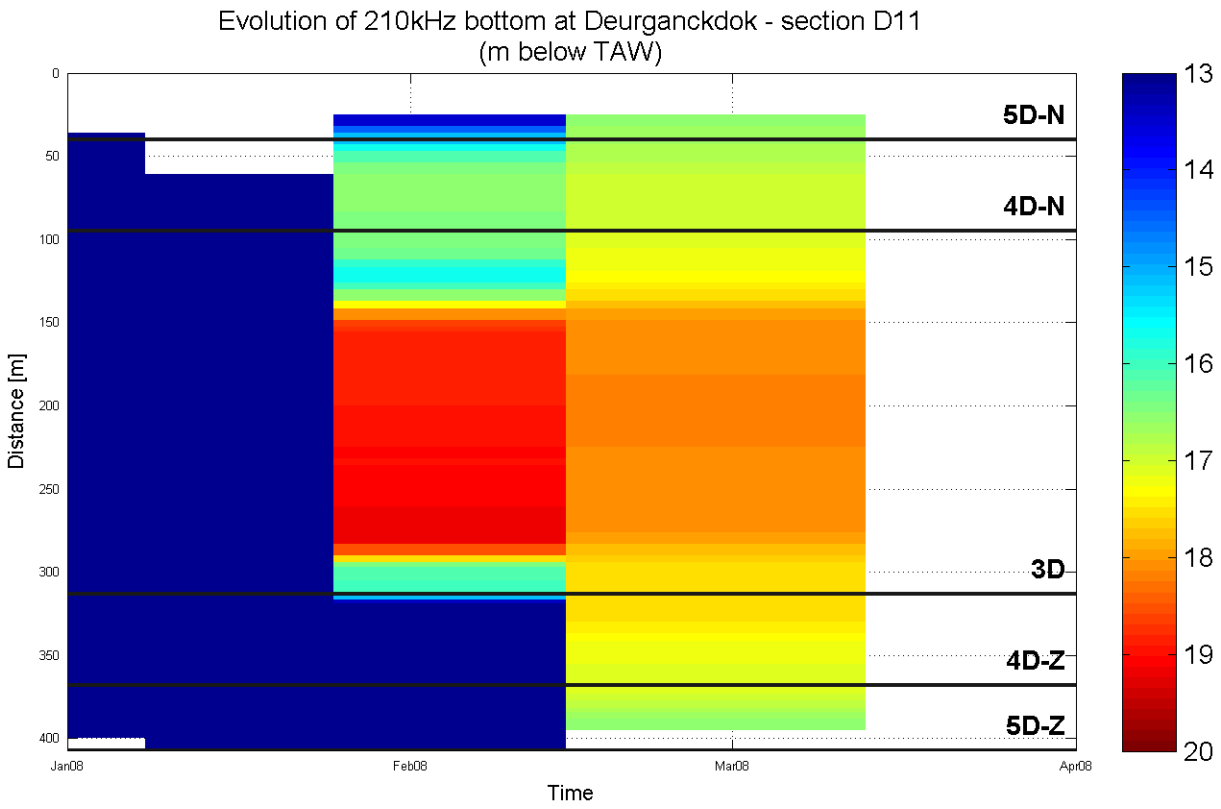
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



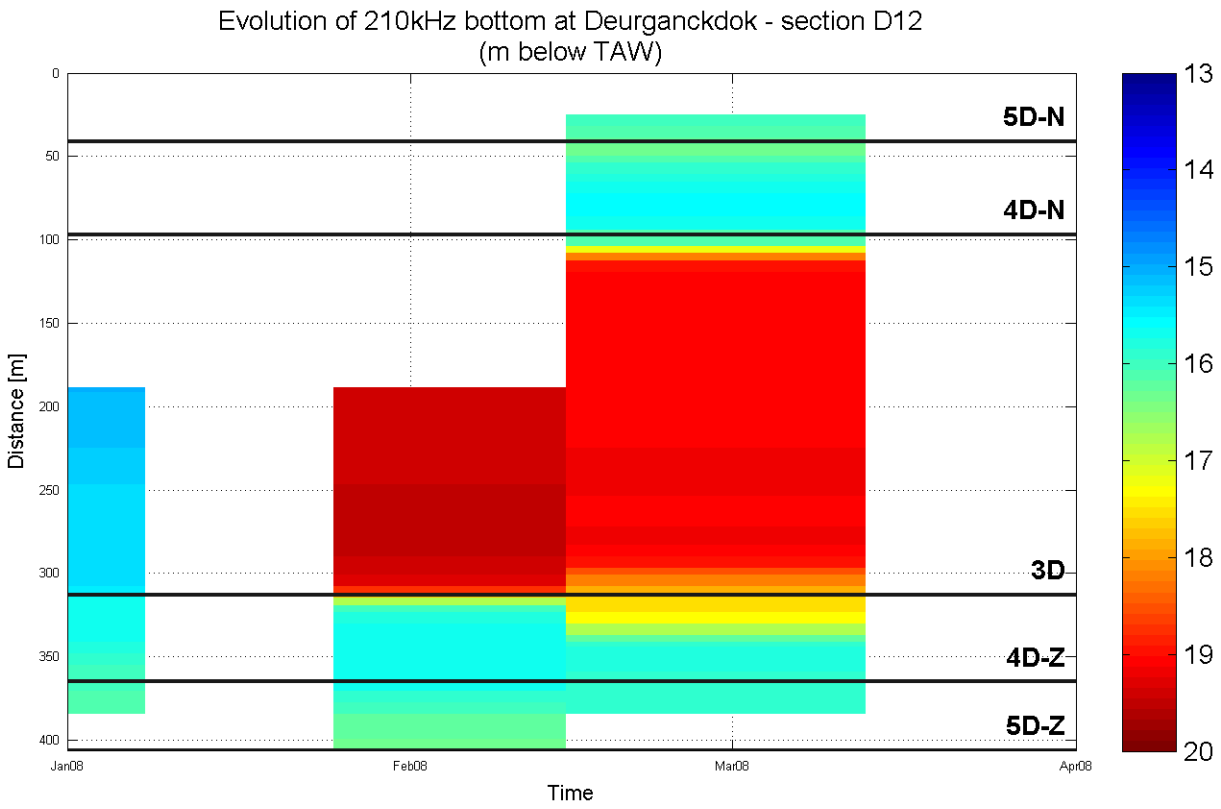
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



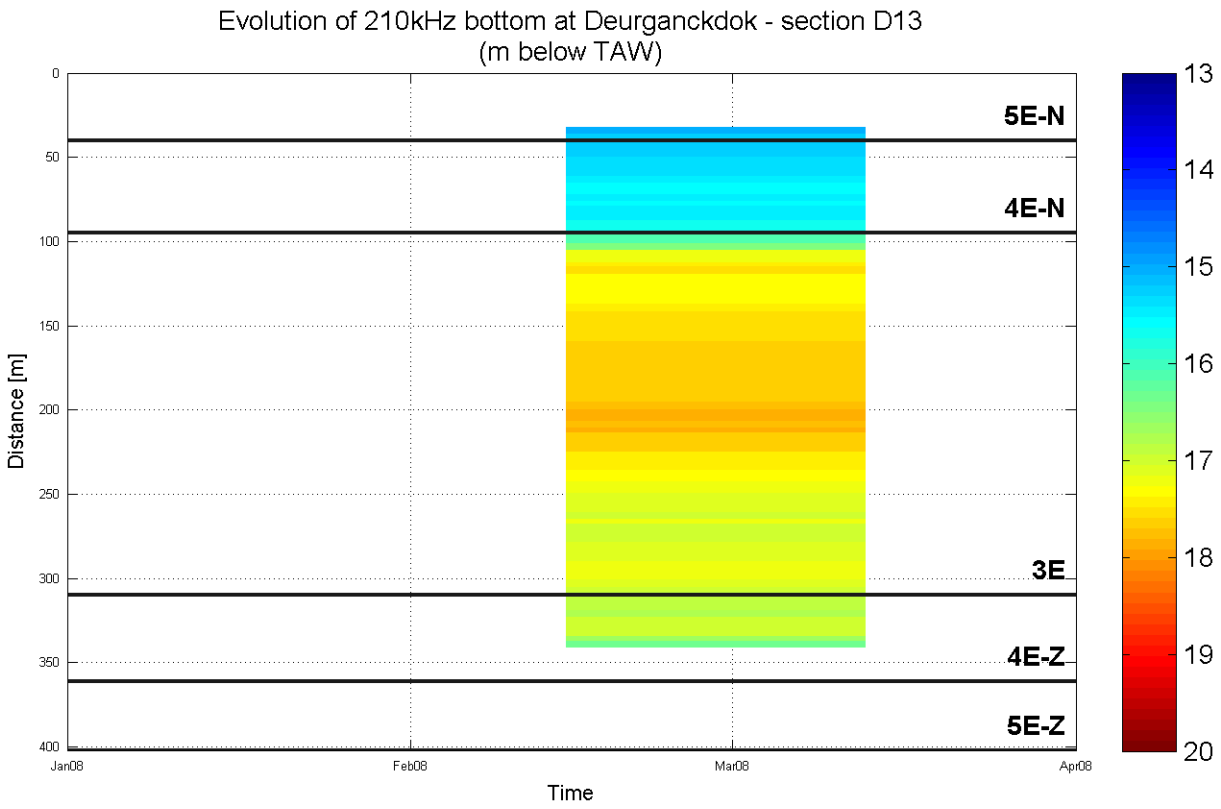
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



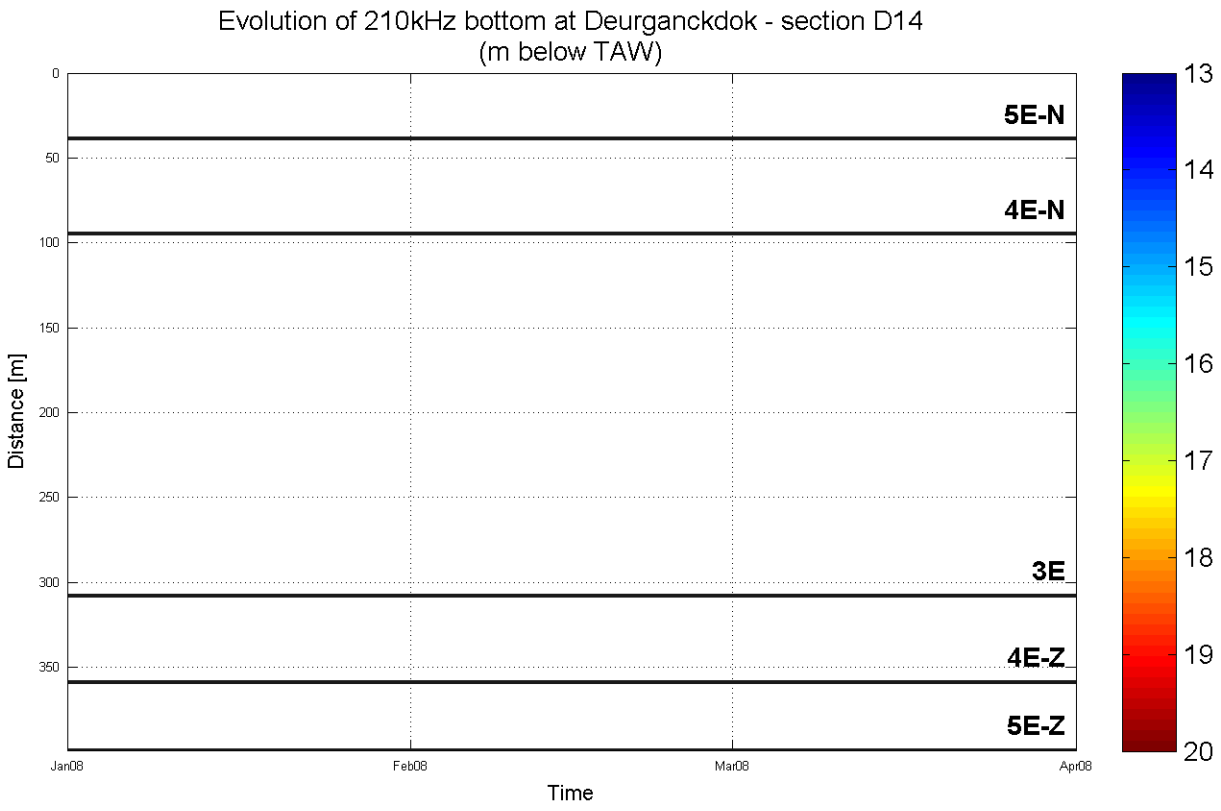
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



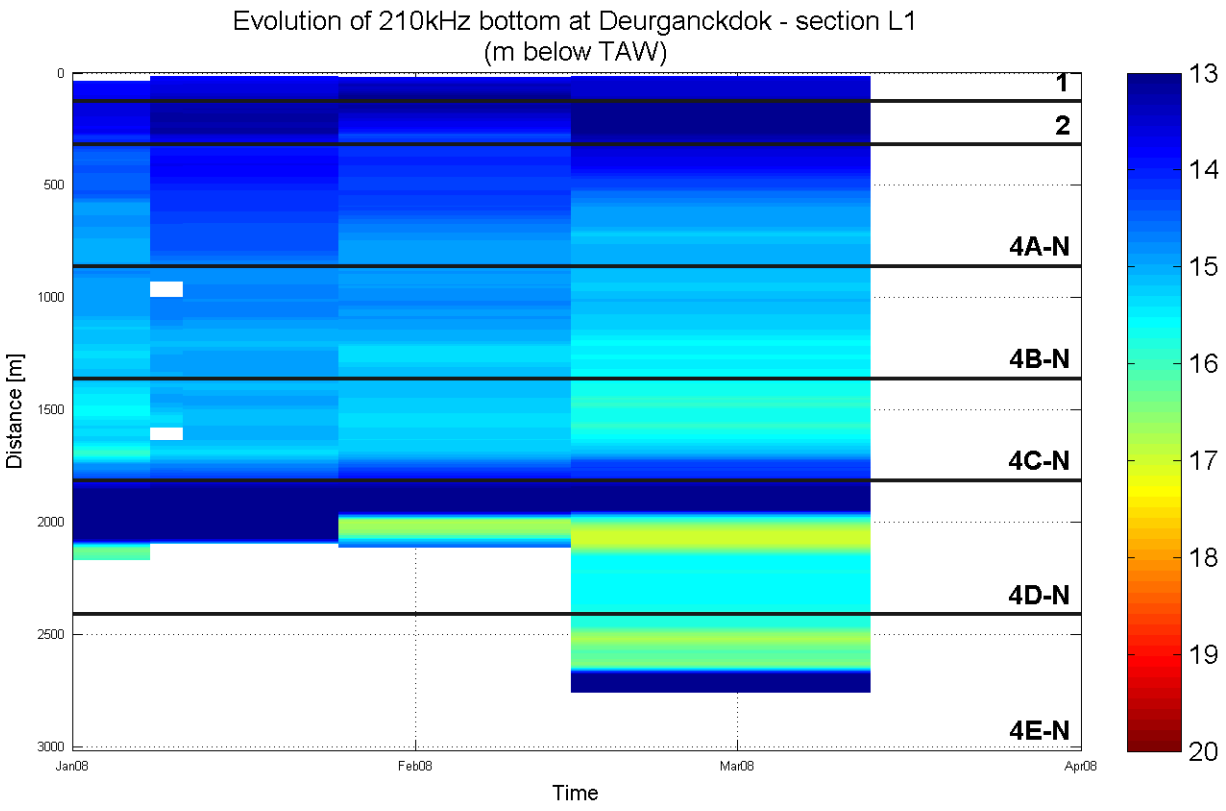
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



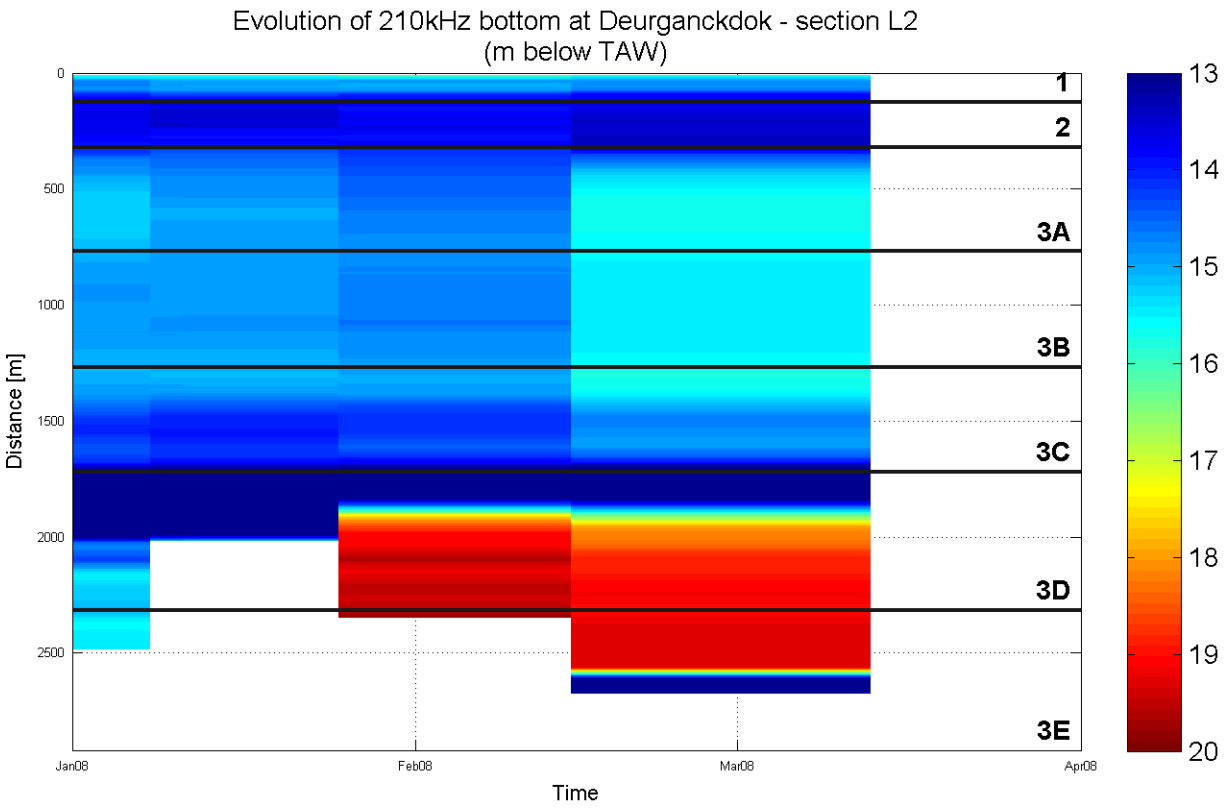
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



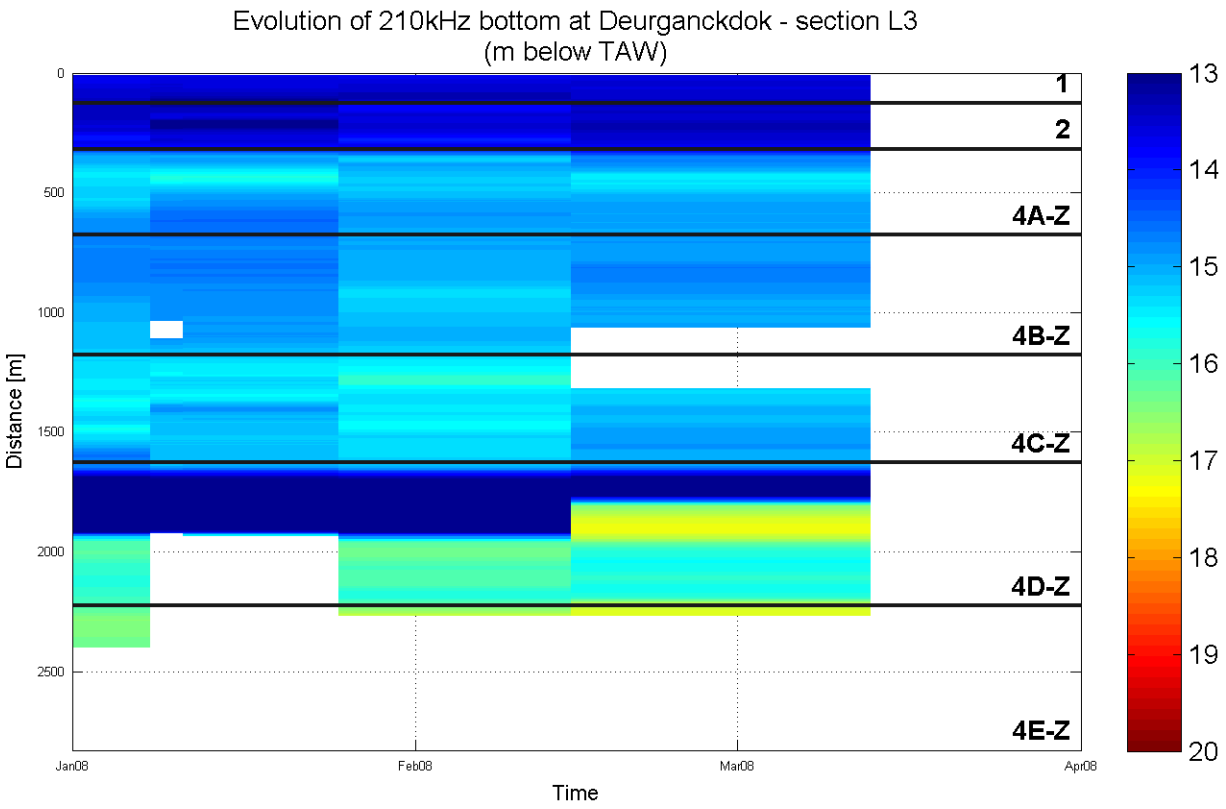
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution 210kHz bottom	Equipment(s): 210kHz depth sounder
	Location: DGD



Data Processed by:

In association with :

I/RA/11283/07.084/MSA

APPENDIX C.

VOLUMETRIC SILTATION RATES IN DIFFERENT ZONES AND SECTIONS

C.1 Siltation rates (tabular)

Siltation rates in cm/day

1/ Per zone

	Jan/08	Feb/08	Mar/08
1	-	-	-
2	-0.234	-0.452	-2.681
3a	0.103	-1.282	0.795
3b	-0.349	-0.555	2.036
3c	-0.49	-0.909	0.112
3d	-	-	-
3e	-	-	-
4Na	-0.441	-0.818	-1.23
4Nb	-0.693	-0.299	0.729
4Nc	-0.171	-0.185	0.394
4Nd	-	-	-
4Ne	-	-	-
4Za	-0.022	-0.502	-0.823
4Zb	-0.651	-0.141	-0.372
4Zc	0.15	-0.107	-1.293
4Zd	-	-	-
4Ze	-	-	-
5Na	-	-	-
5Nb	-	-	-
5Nc	-	-	-
5Nd	-	-	-
5Ne	-	-	-
5Za	-	-	-
5Zb	-	-	-
5Zc	-	-	-
5Zd	-	-	-

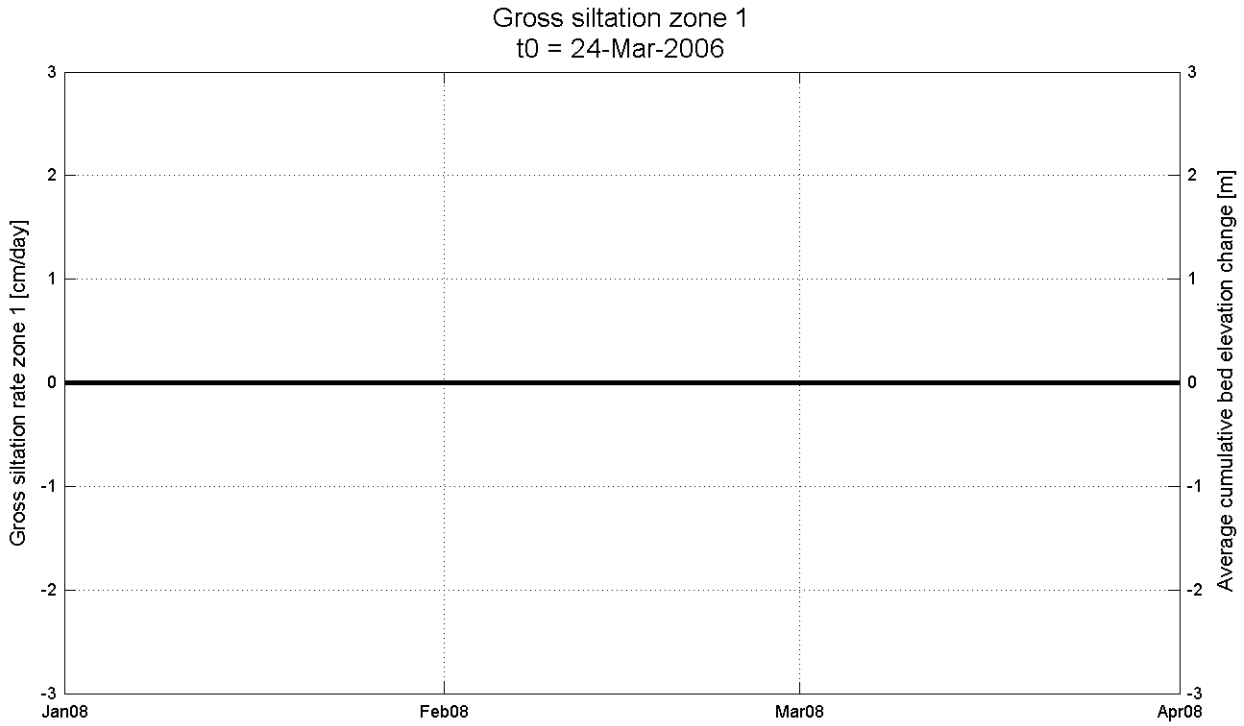
2/ Per section

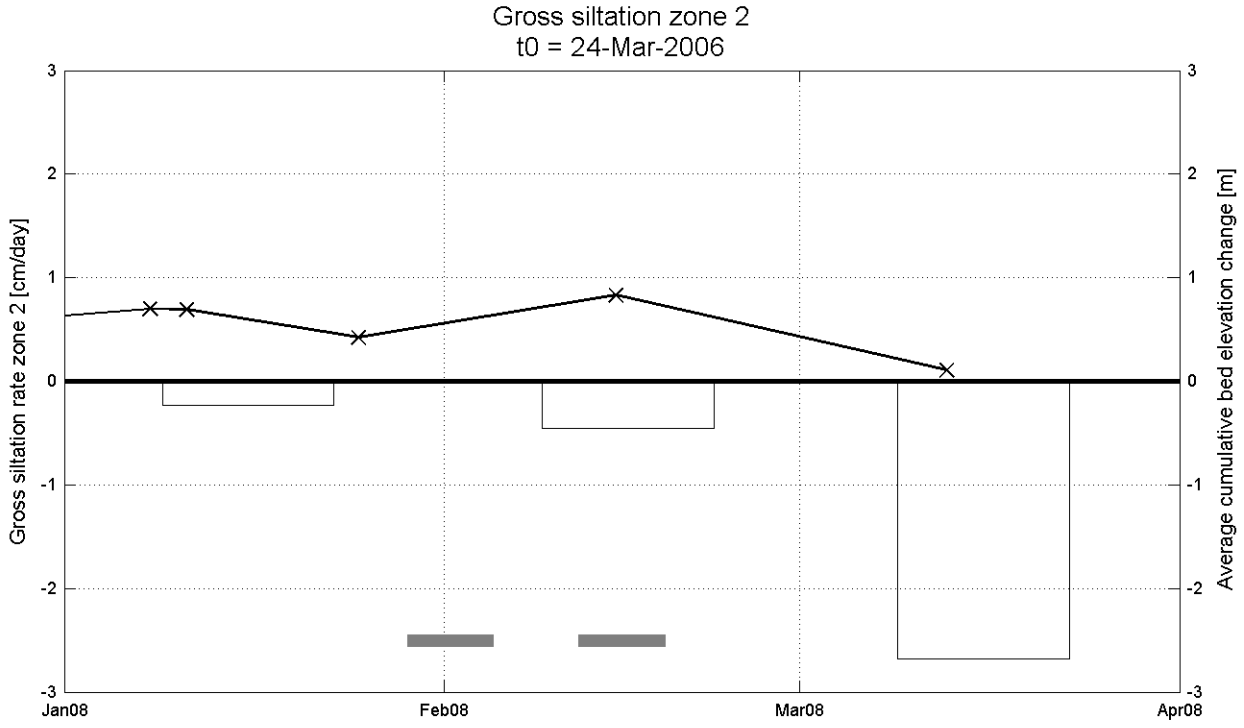
	Jan/08	Feb/08	Mar/08
D1	-0.182	-1.412	-3.547
D2	-0.461	-0.146	2.312
D3	-0.565	-0.3	1.479
D4	-0.595	-0.583	1.033
D5	0.087	-1.192	-0.177
D6	0.251	-0.712	-3.129
D7	-0.296	-0.457	-2.67
D8	-	-	-
D9	-	-	-
D10	-	-	-
D11	-	-	-
D12	-	-	-
D13	-	-	-
D14	-	-	-
L1	-0.283	-0.703	-0.948
L2	-0.377	-1.307	-0.514
L3	-0.365	-0.744	-2.4

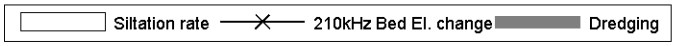
C.2 Water-bed interface evolution for all zones

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

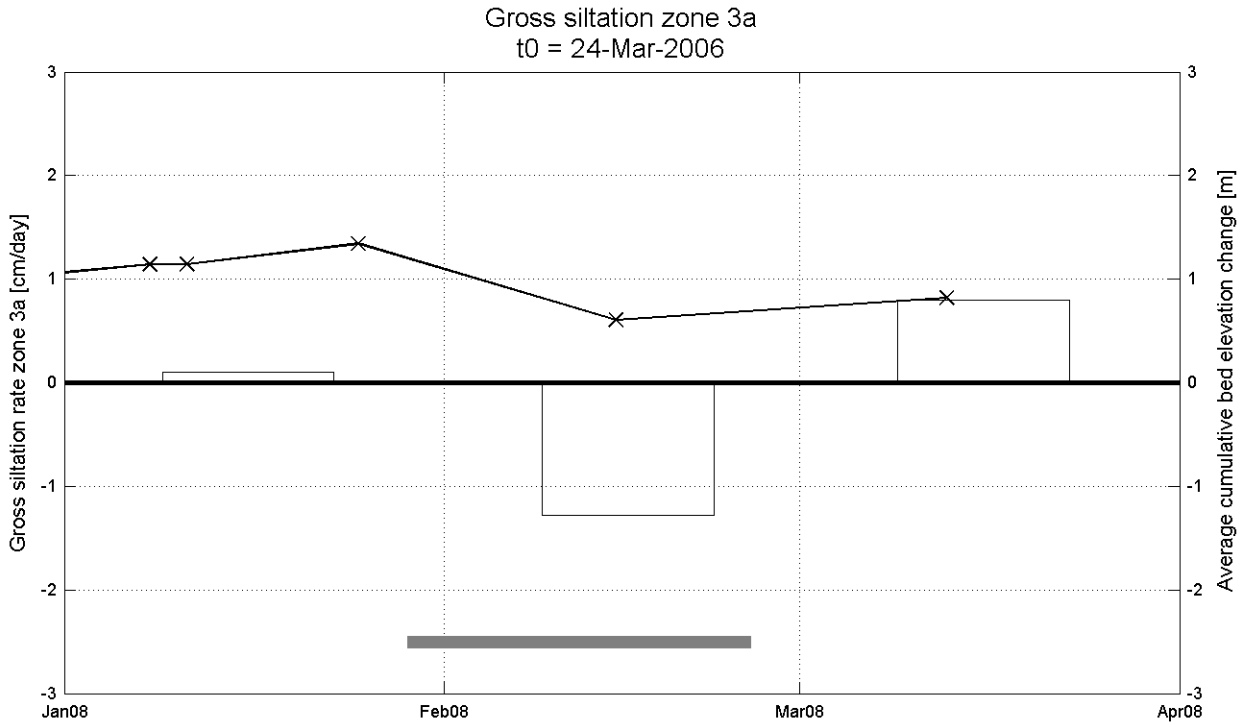
Data Processed by:

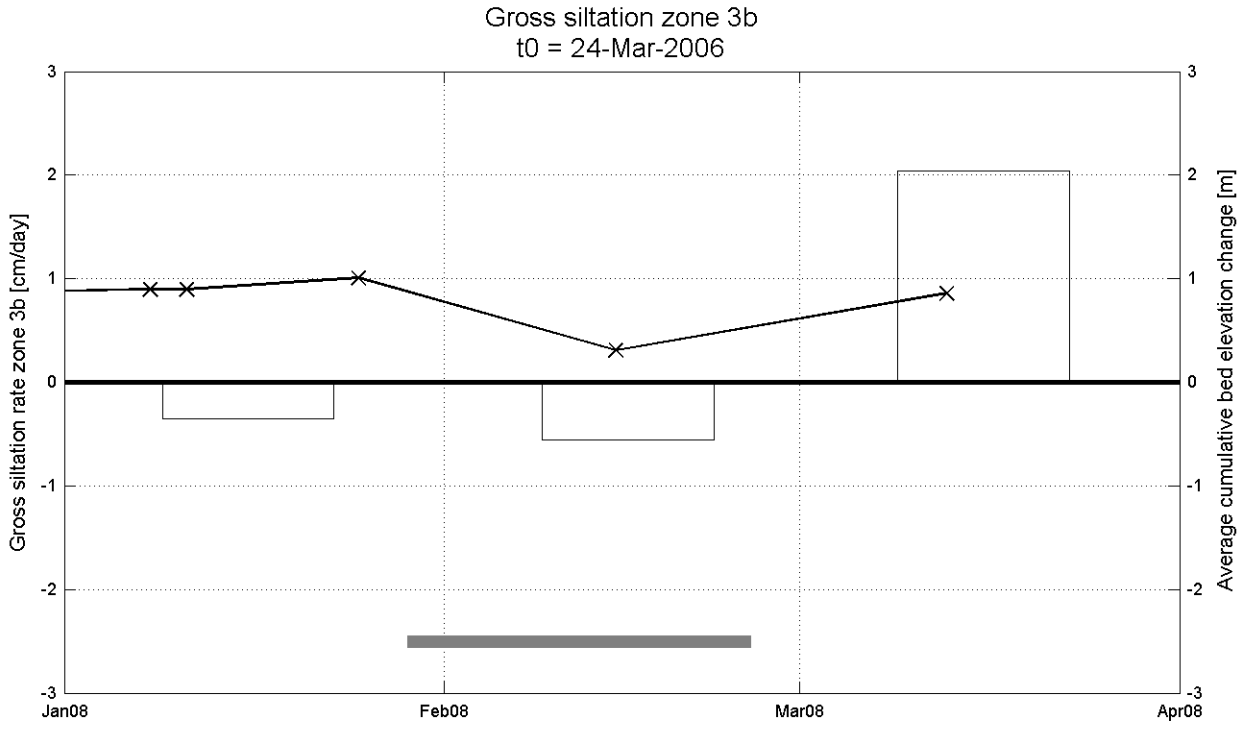
In association with :

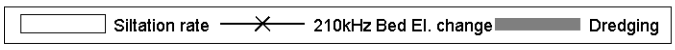
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

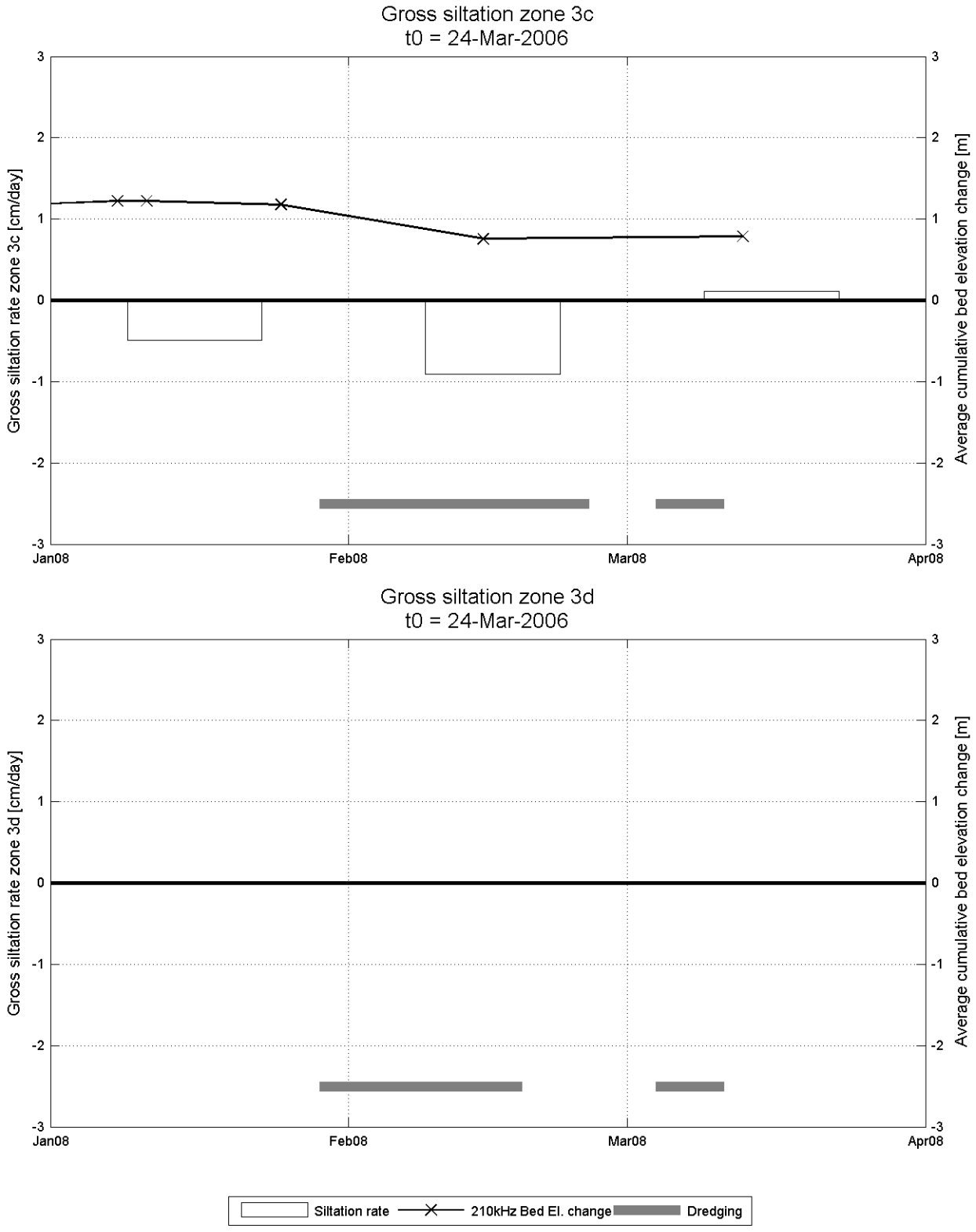
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD



Reference level: depth sounding 24-Mar-2006

Data Processed by:

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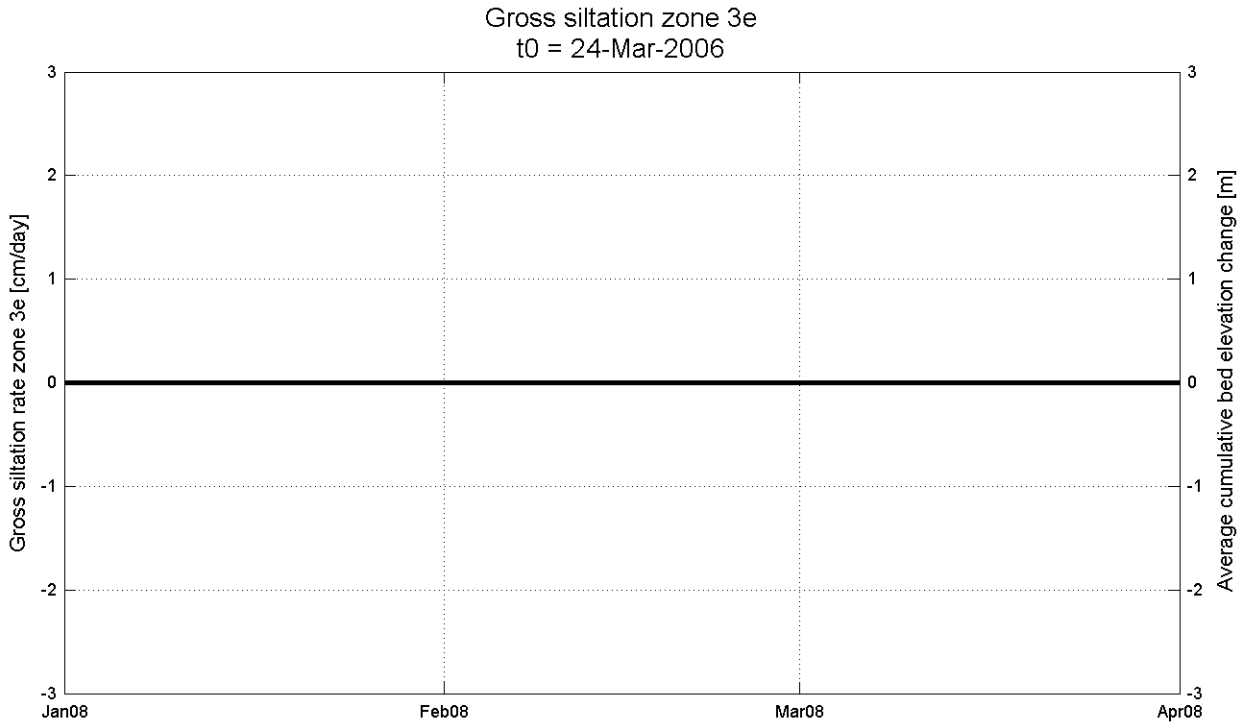
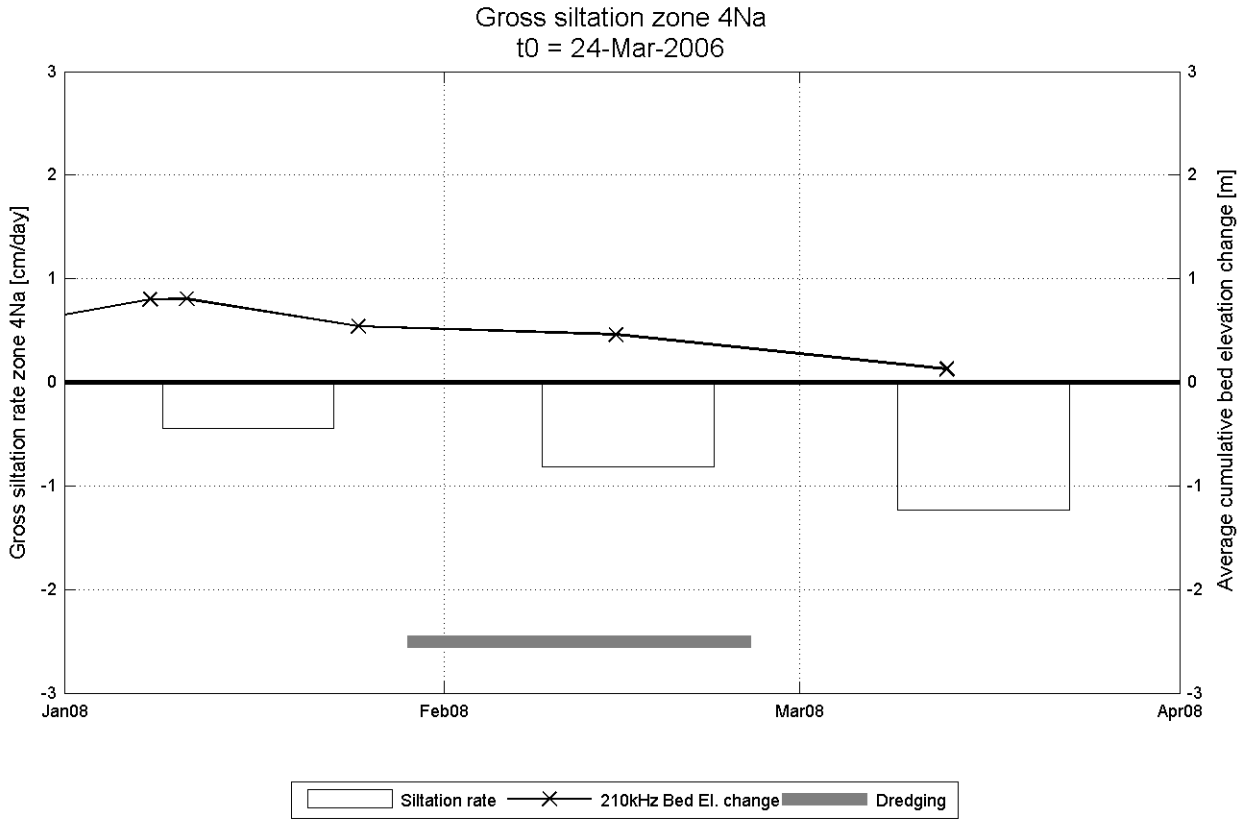
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD





Reference level: depth sounding 24-Mar-2006

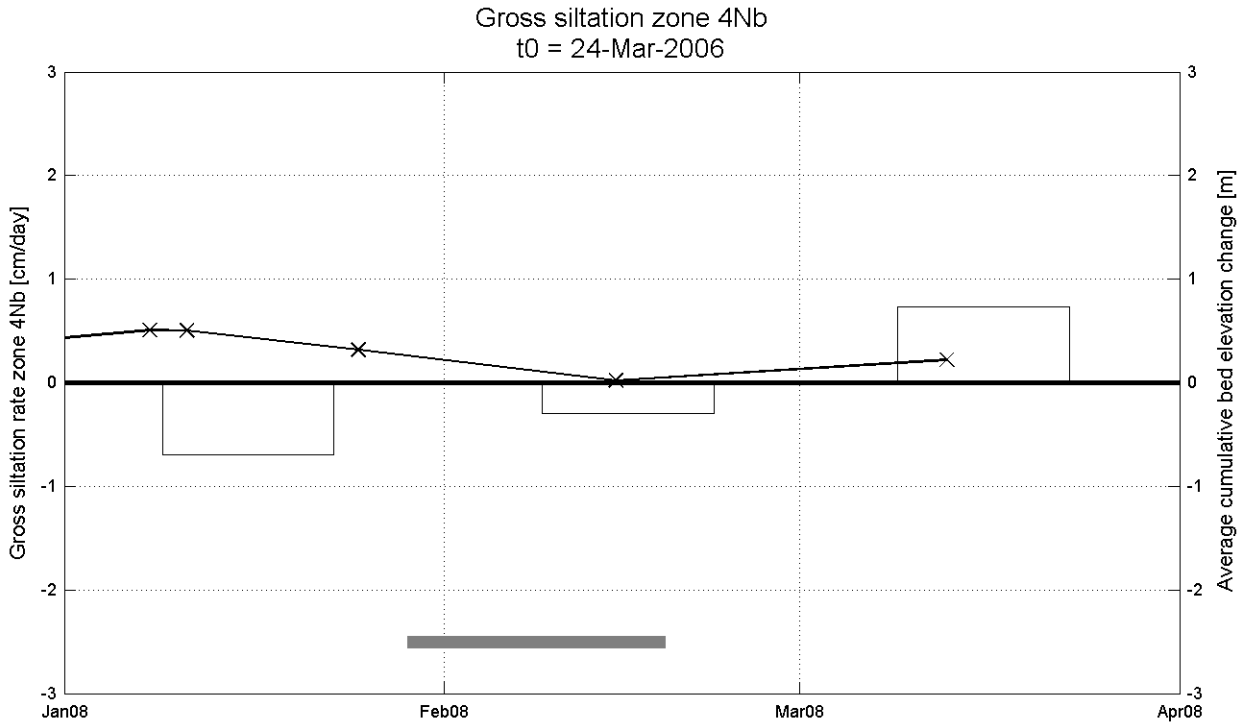
Data Processed by:

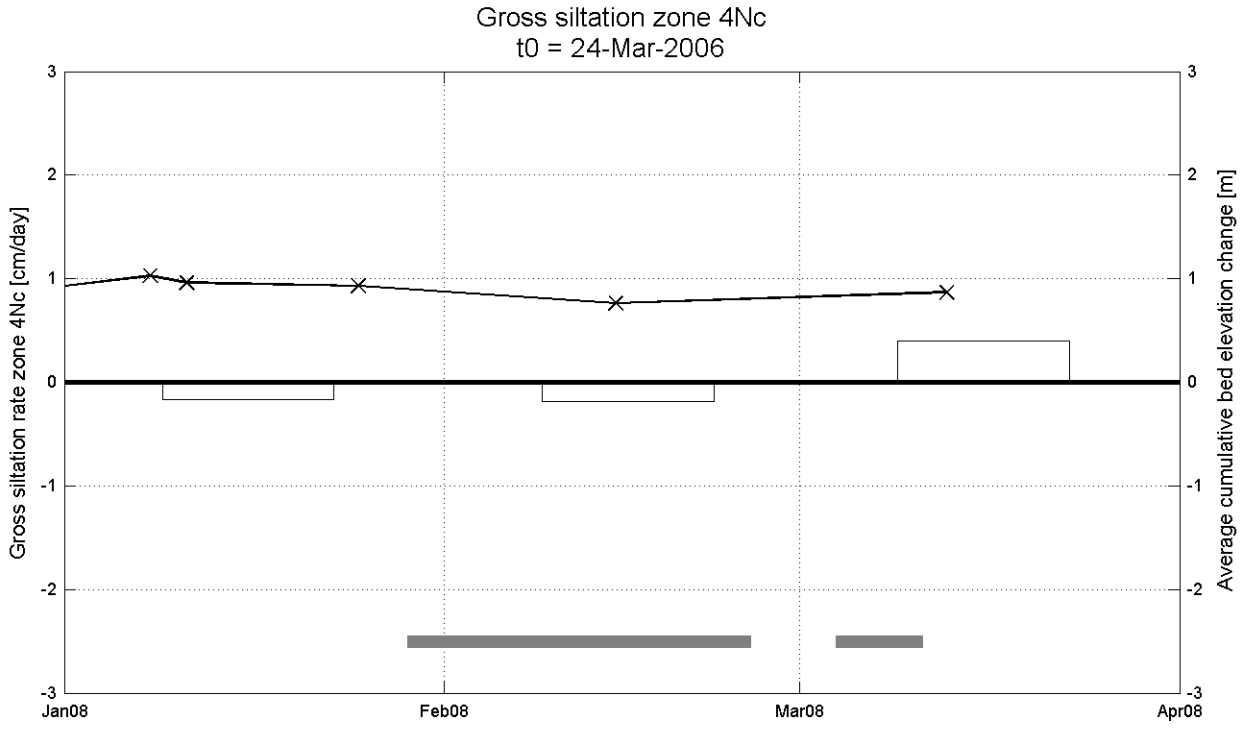
In association with :

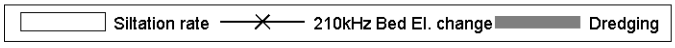
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

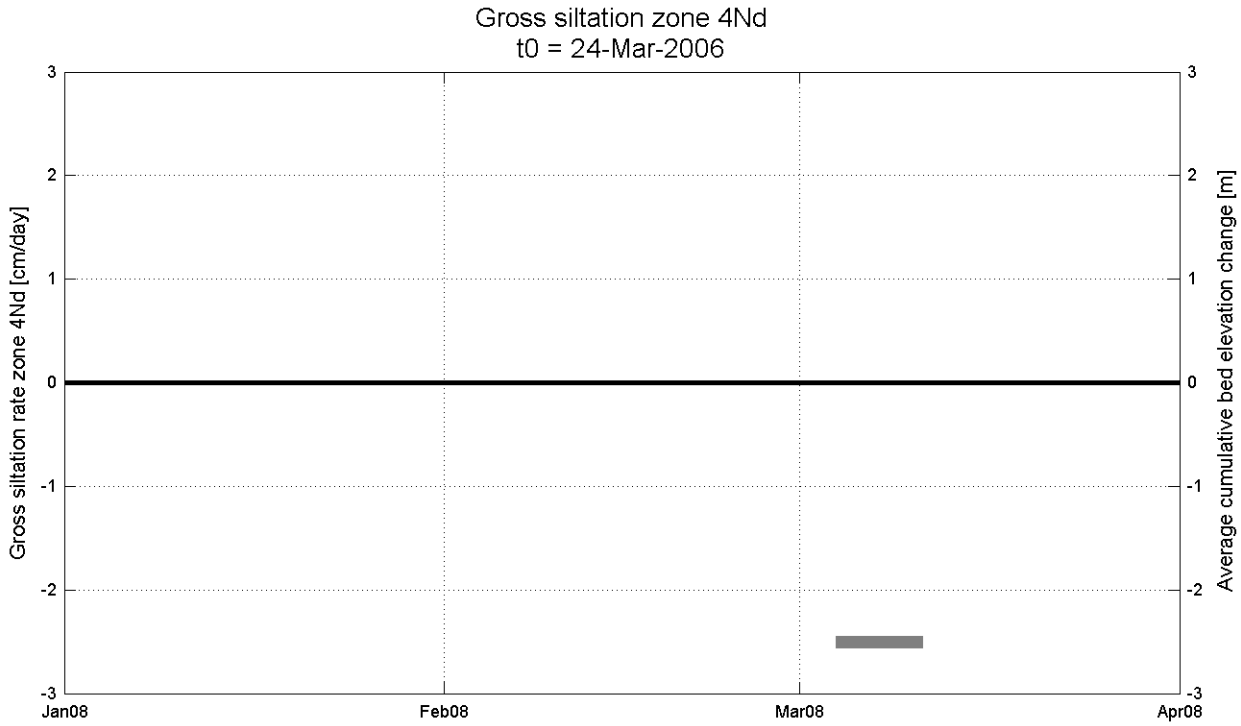
Data Processed by:

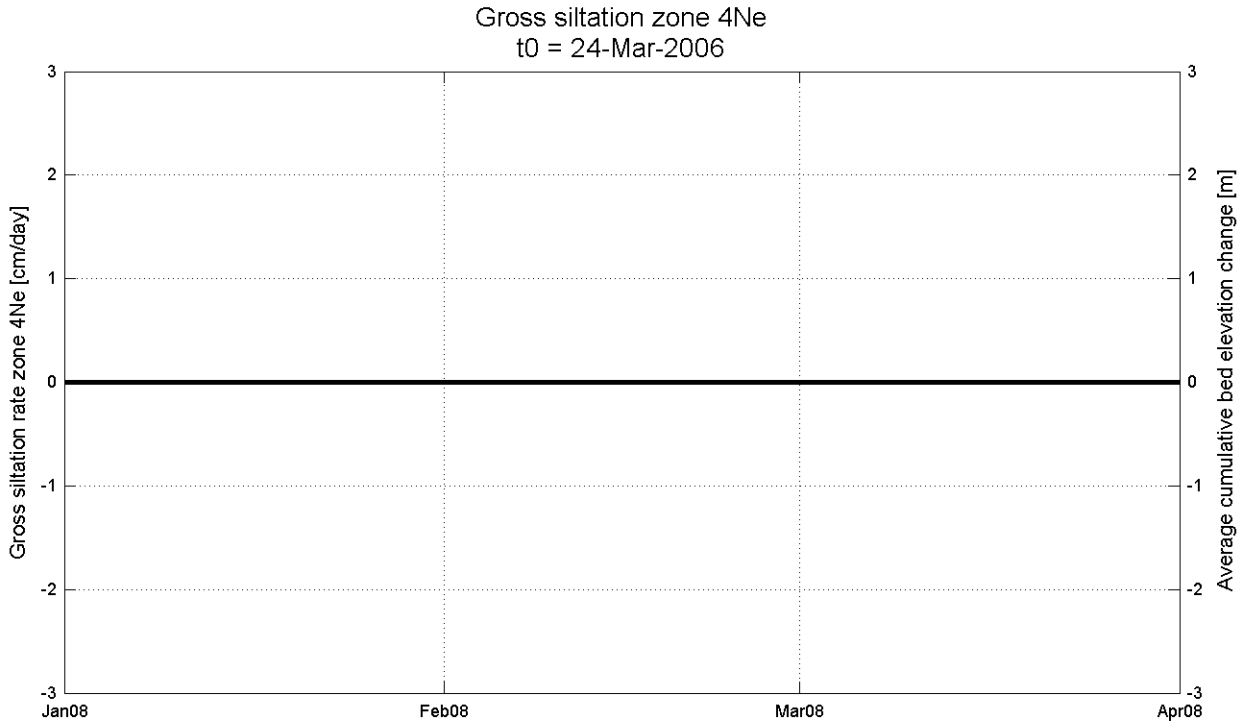
In association with :

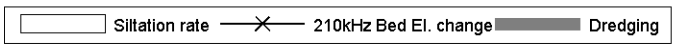
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

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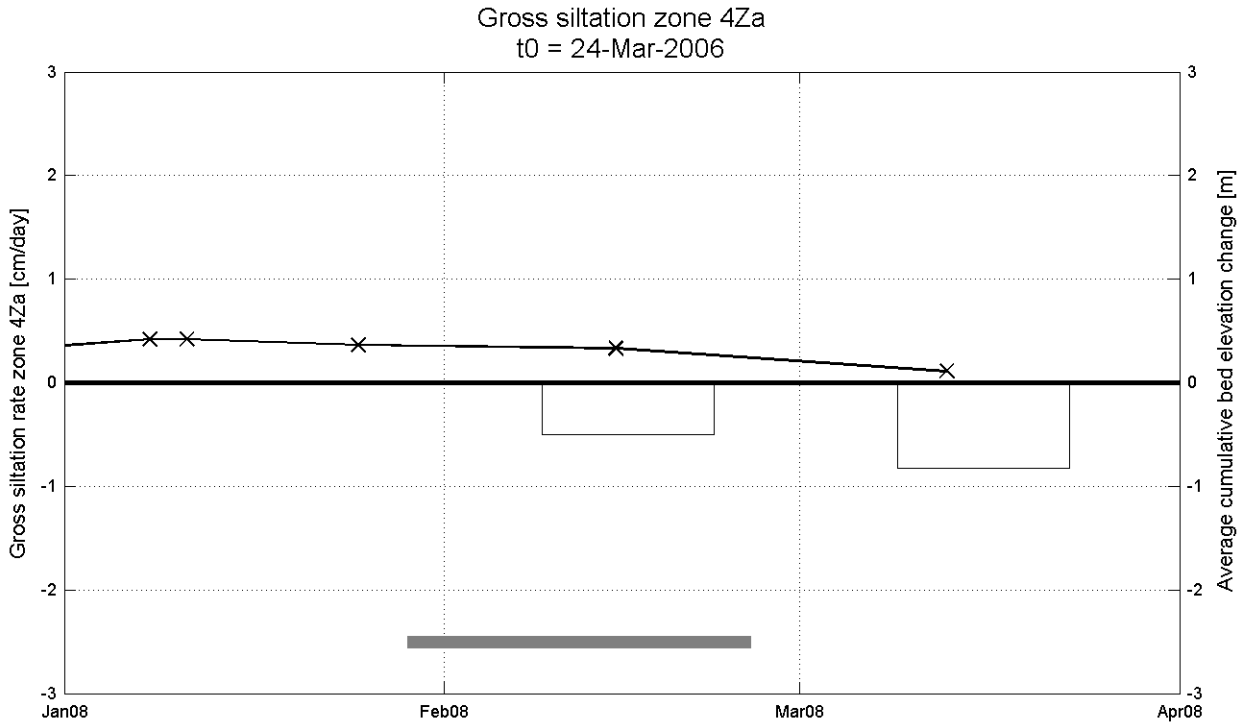
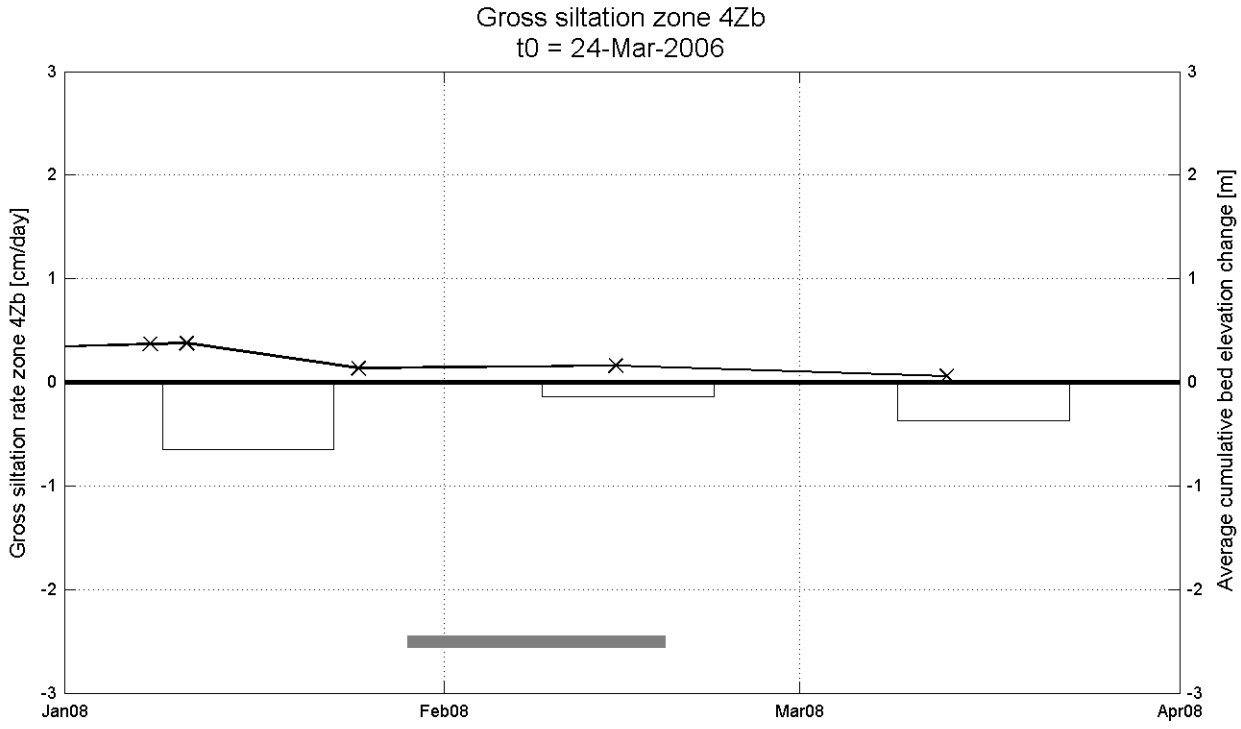
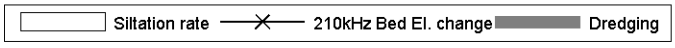
Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

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In association with :

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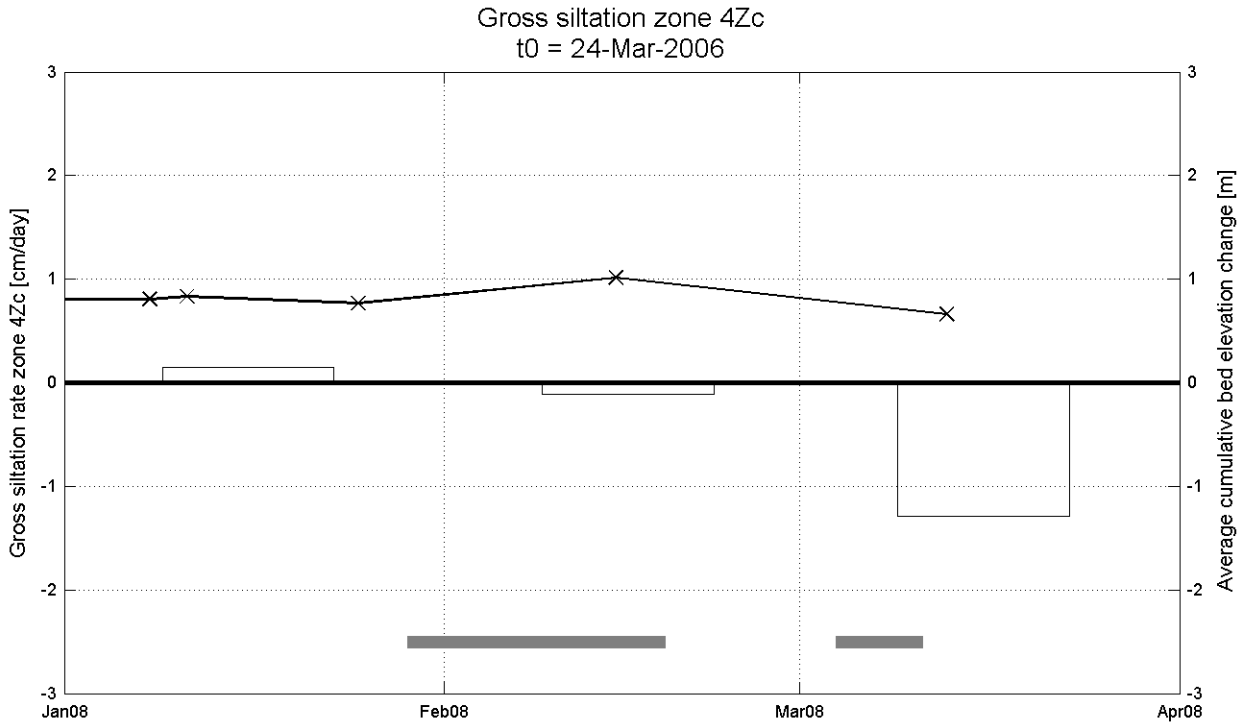
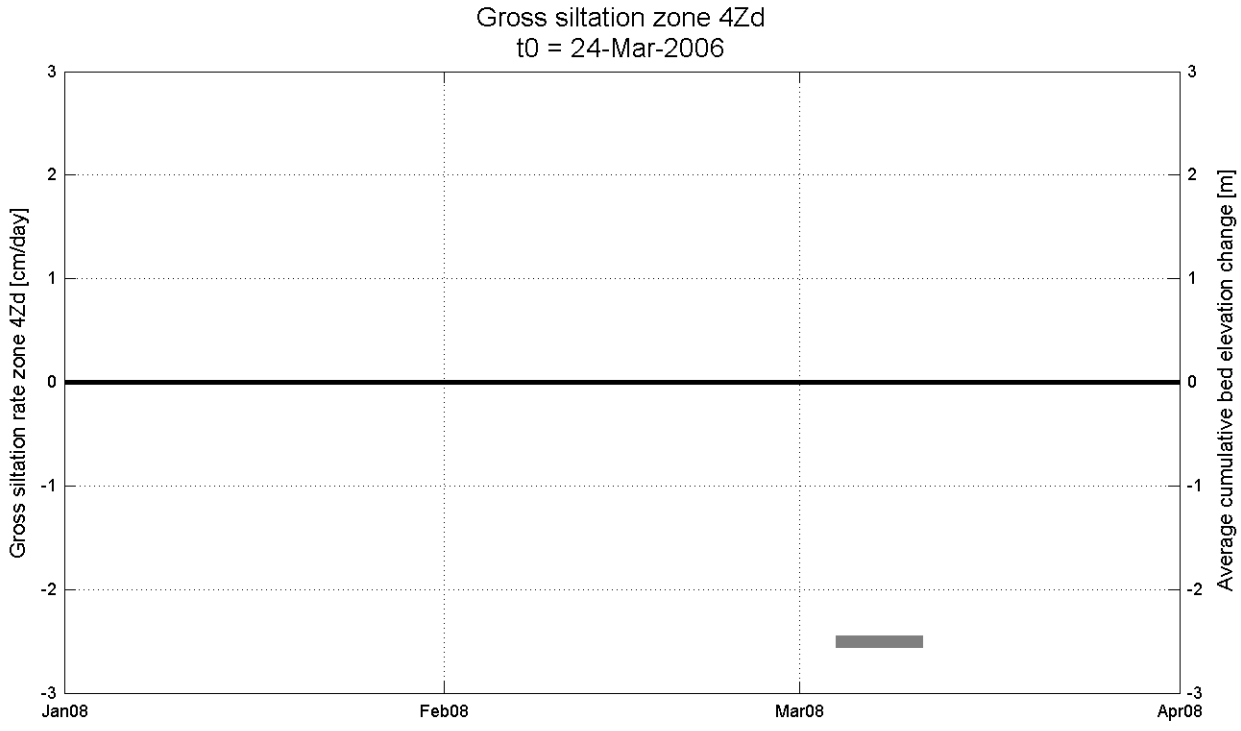
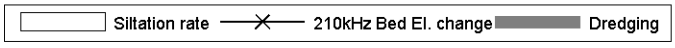
Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

Data Processed by:

In association with :

I/RA/11283/07.084/MSA

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Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
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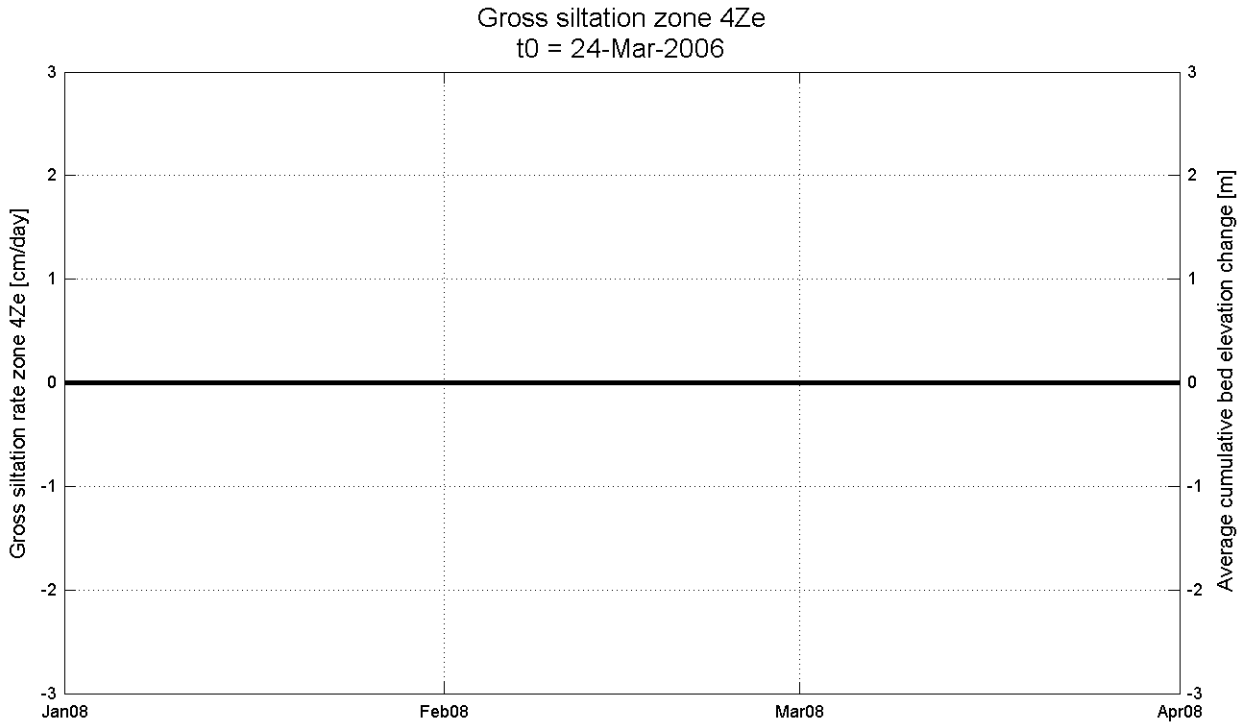
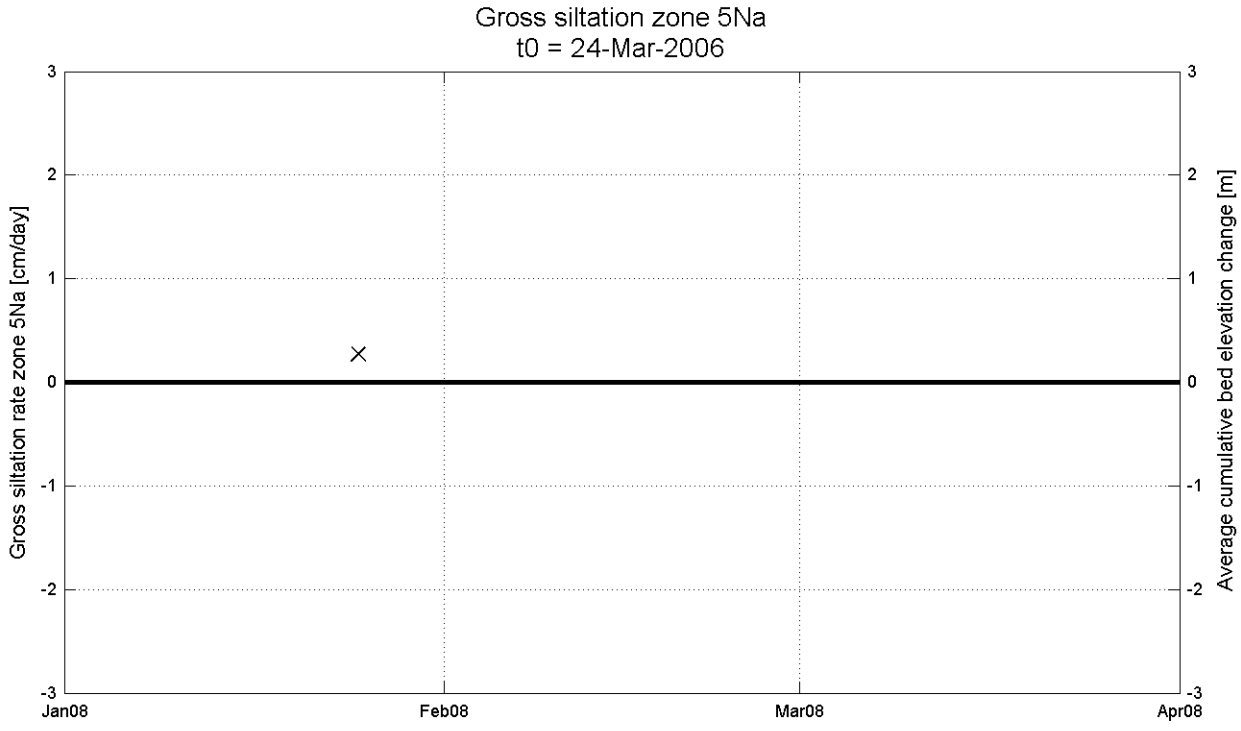
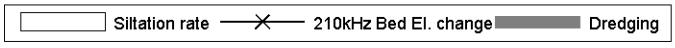






Reference level: depth sounding 24-Mar-2006

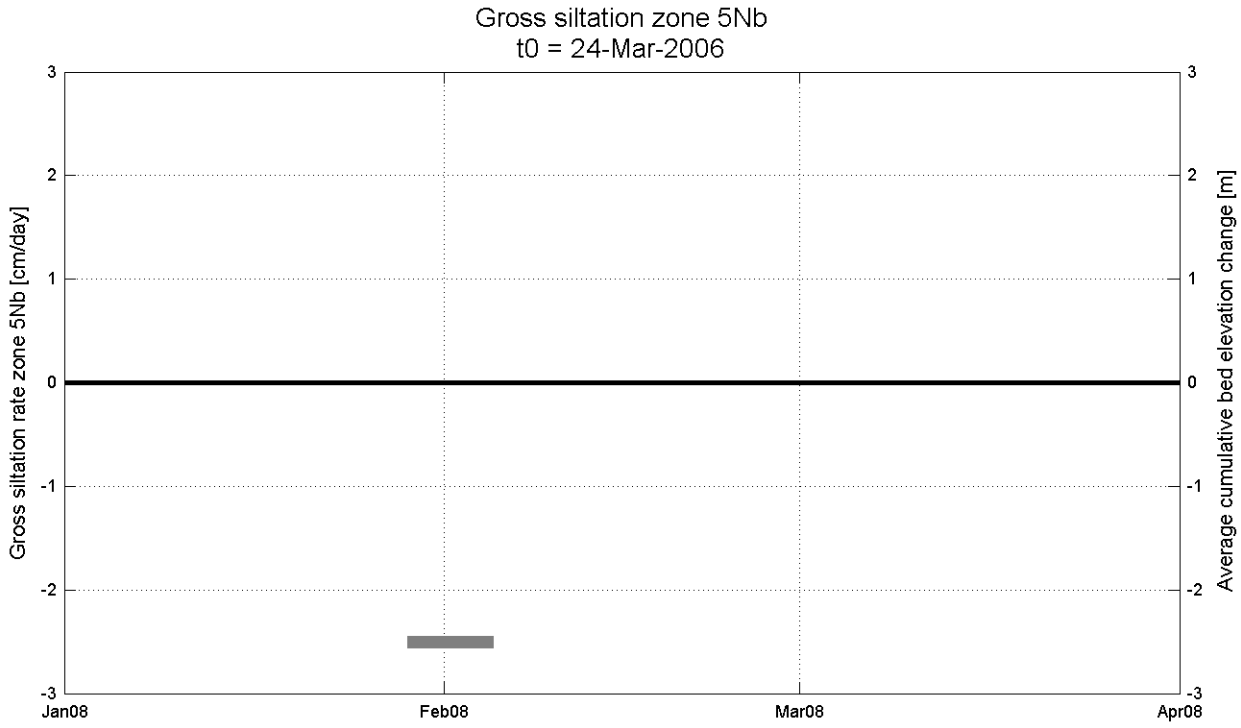
Data Processed by:

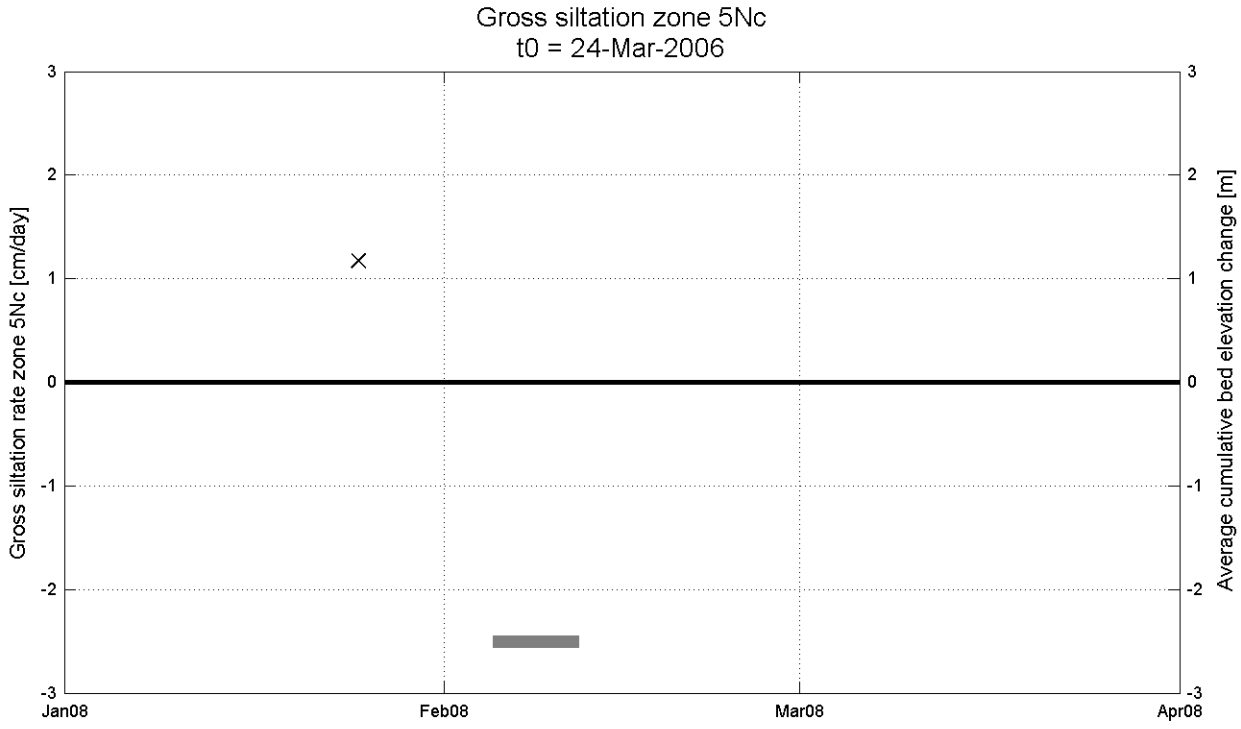
In association with :

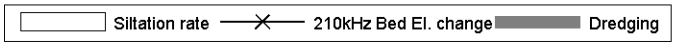
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

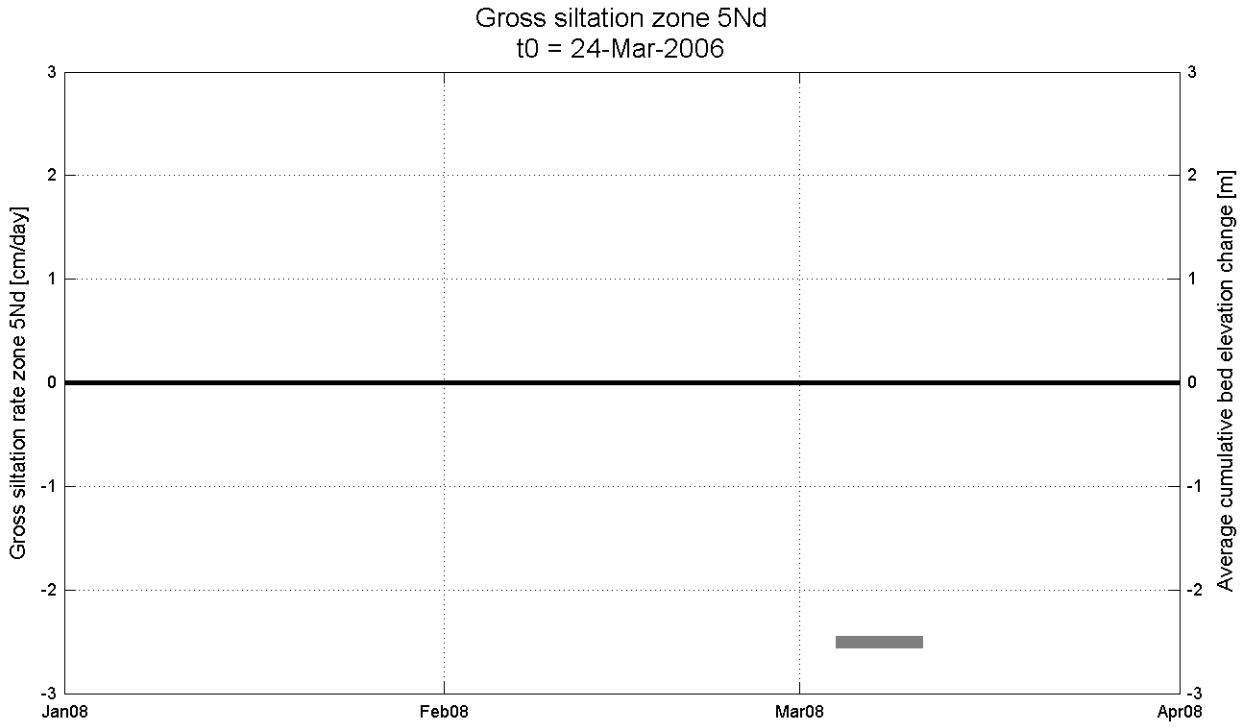
Data Processed by:

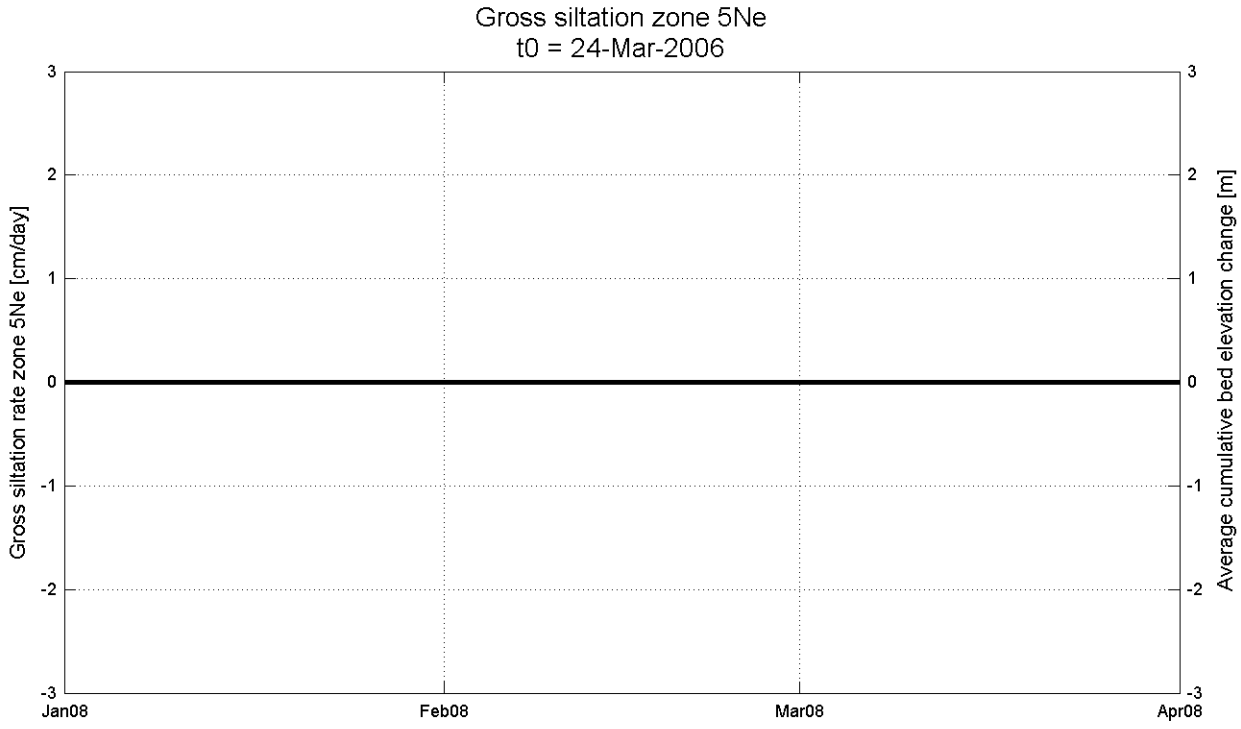
In association with :

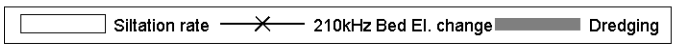
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

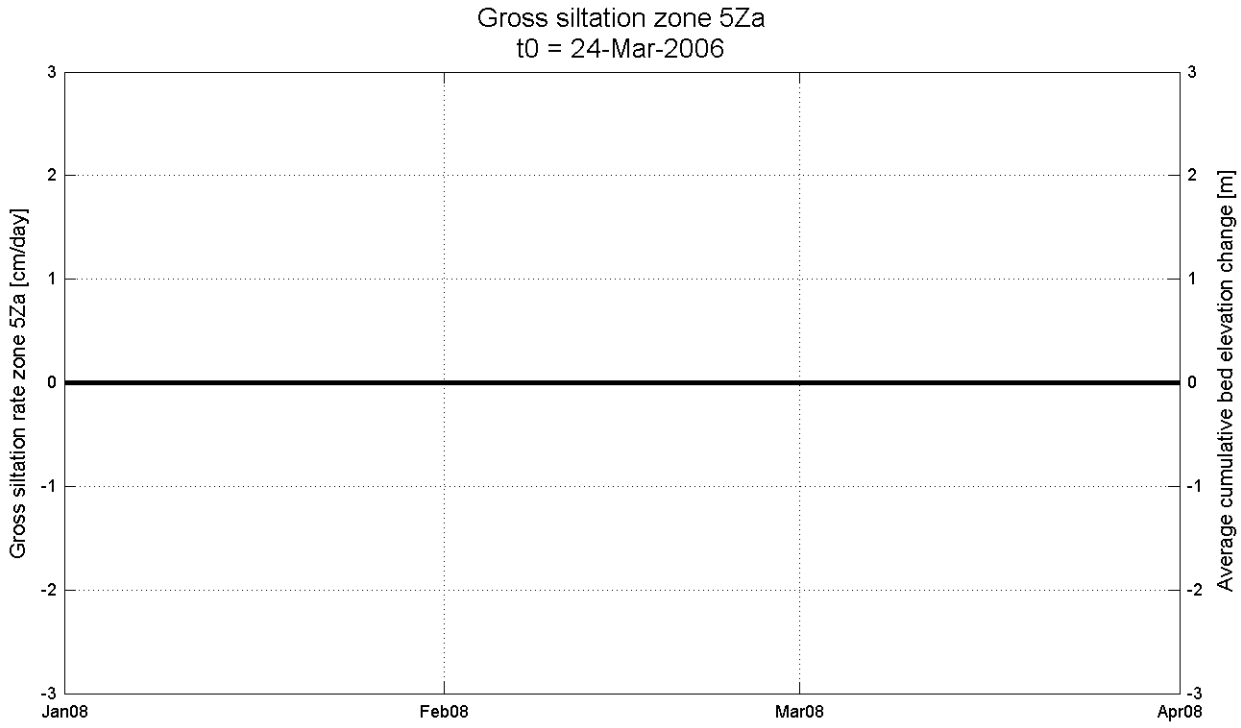
Data Processed by:

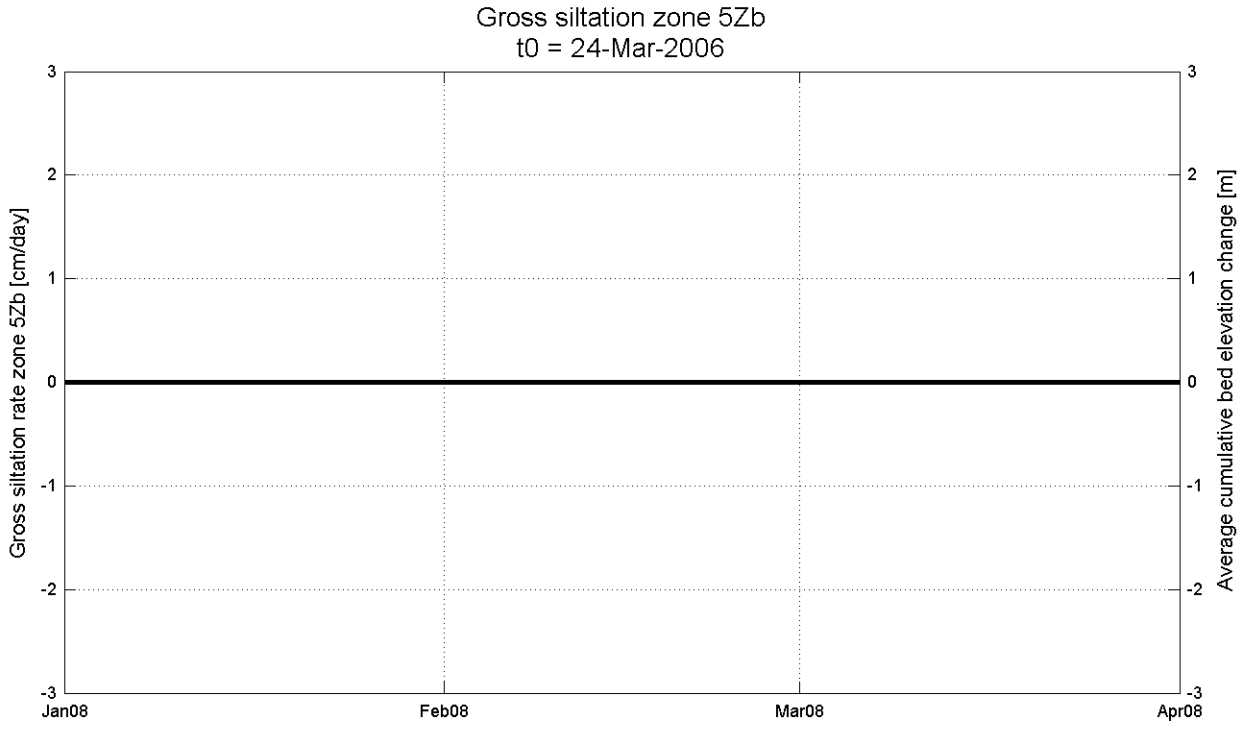
In association with :

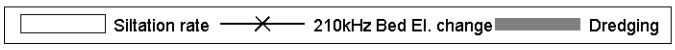
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

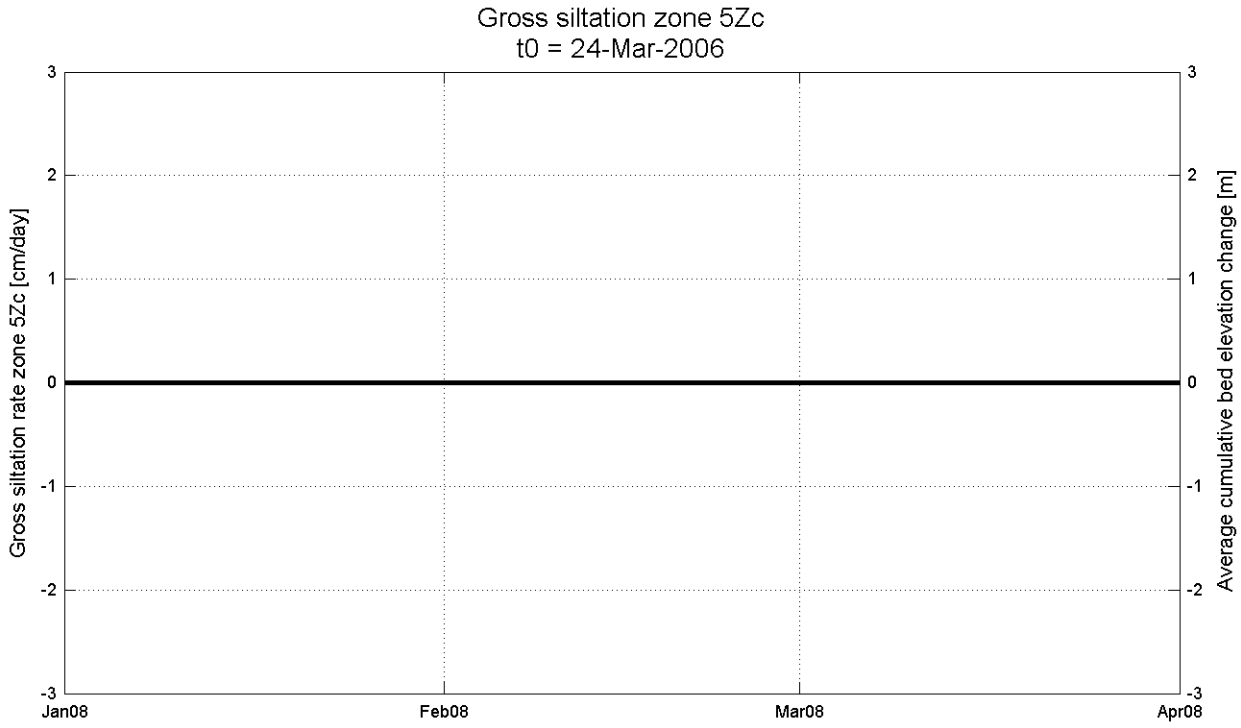
Data Processed by:

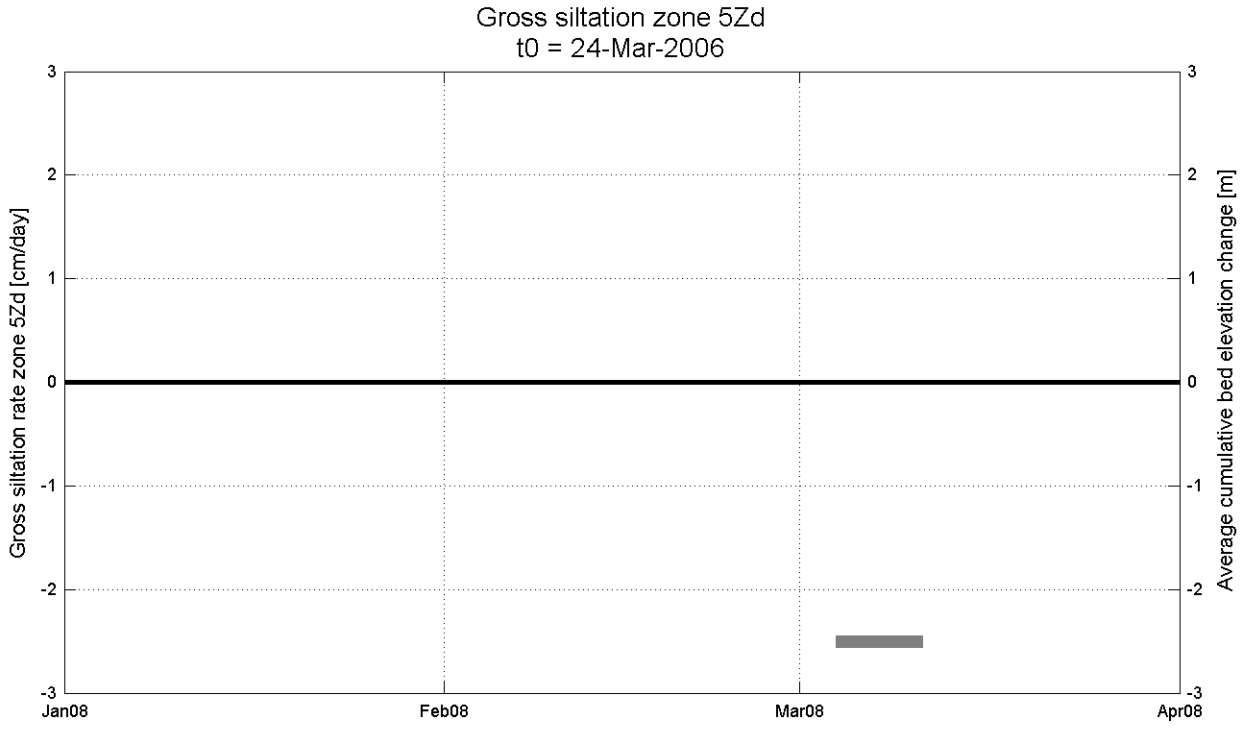
In association with :

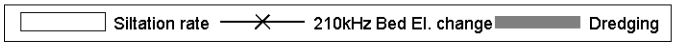
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

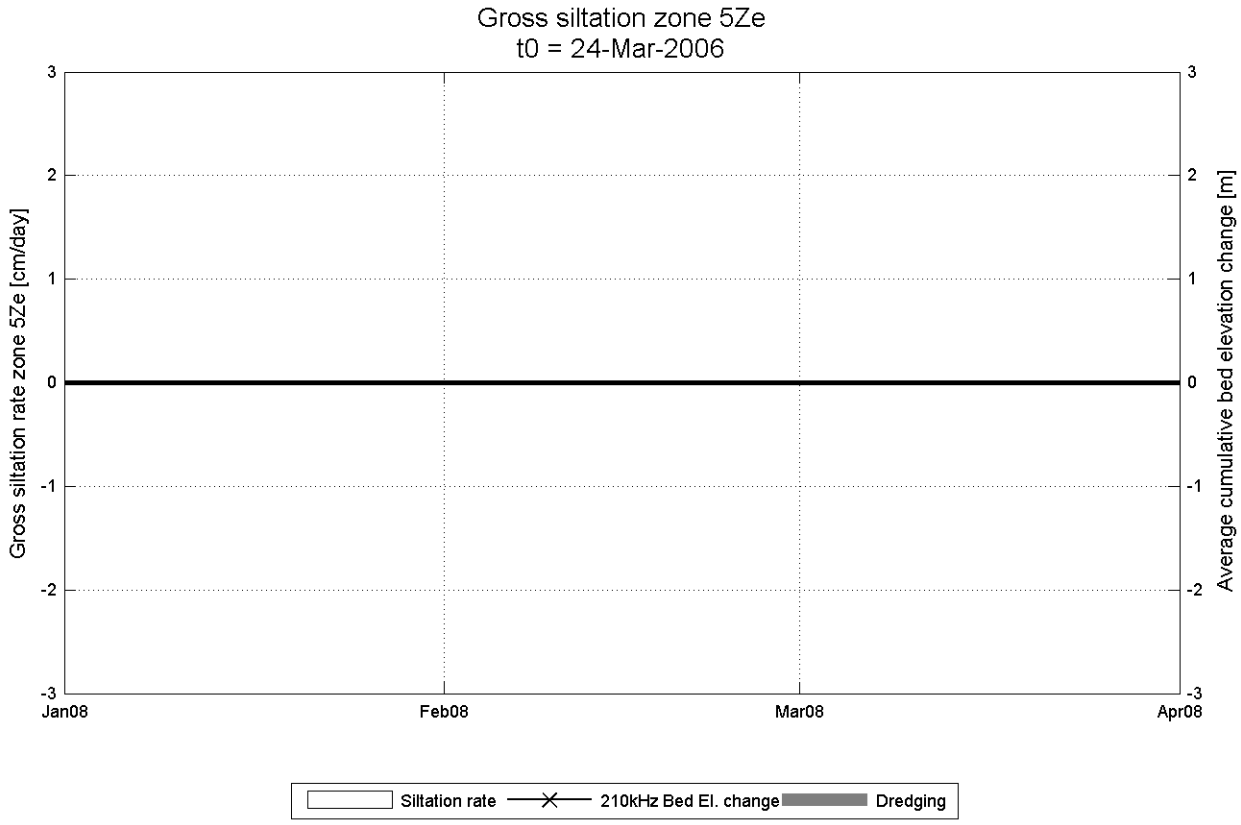
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD



Reference level: depth sounding 24-Mar-2006

Data Processed by:

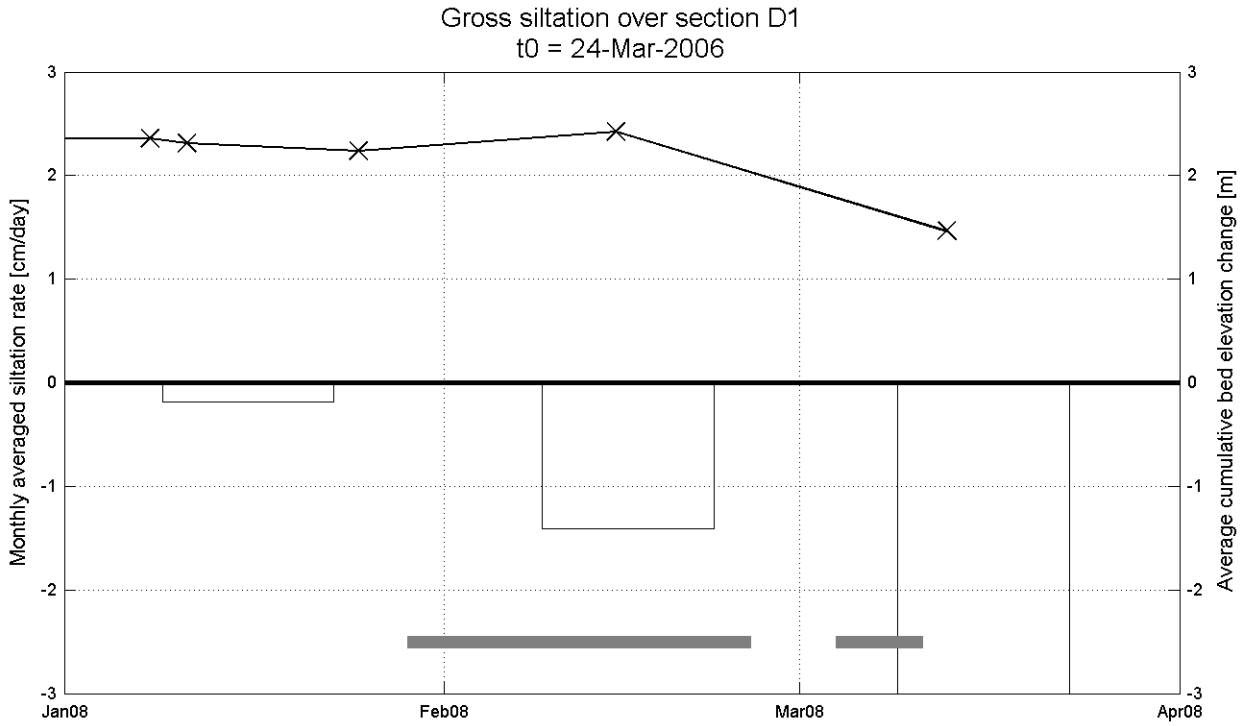
In association with :

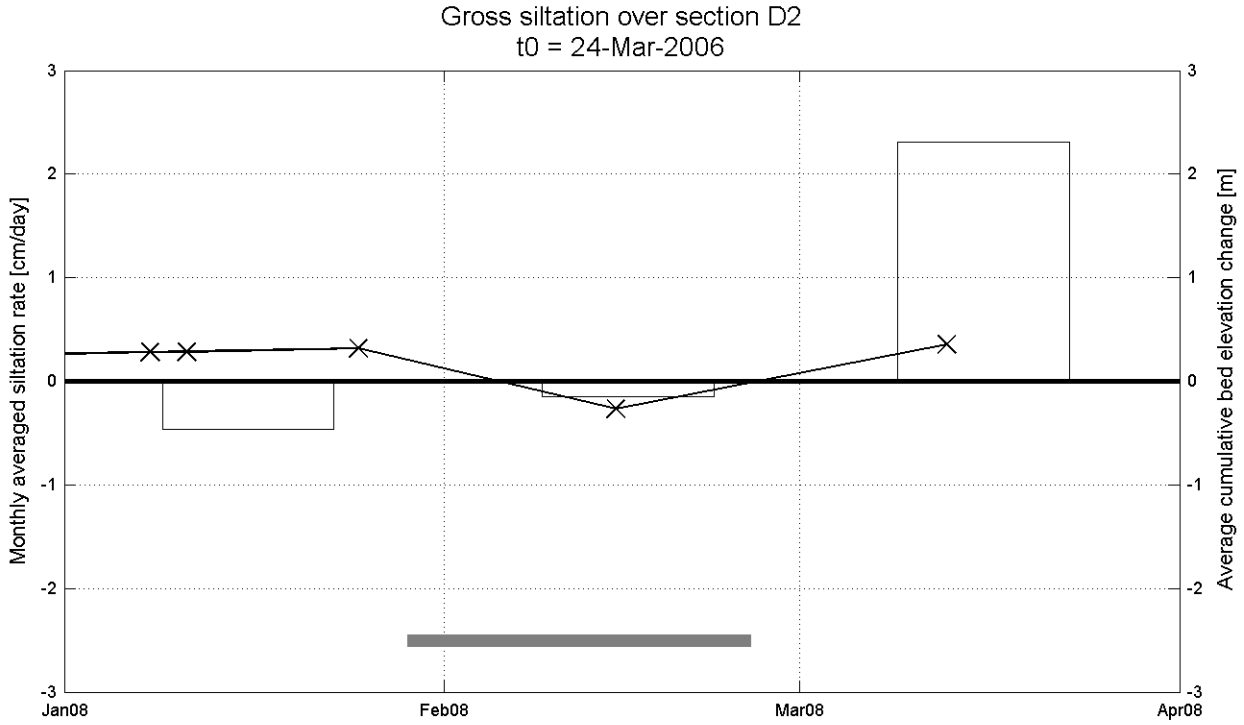
I/RA/11283/07.084/MSA

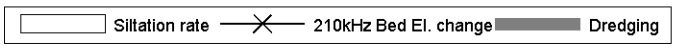
C.3 Water-bed interface evolution for all sections

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

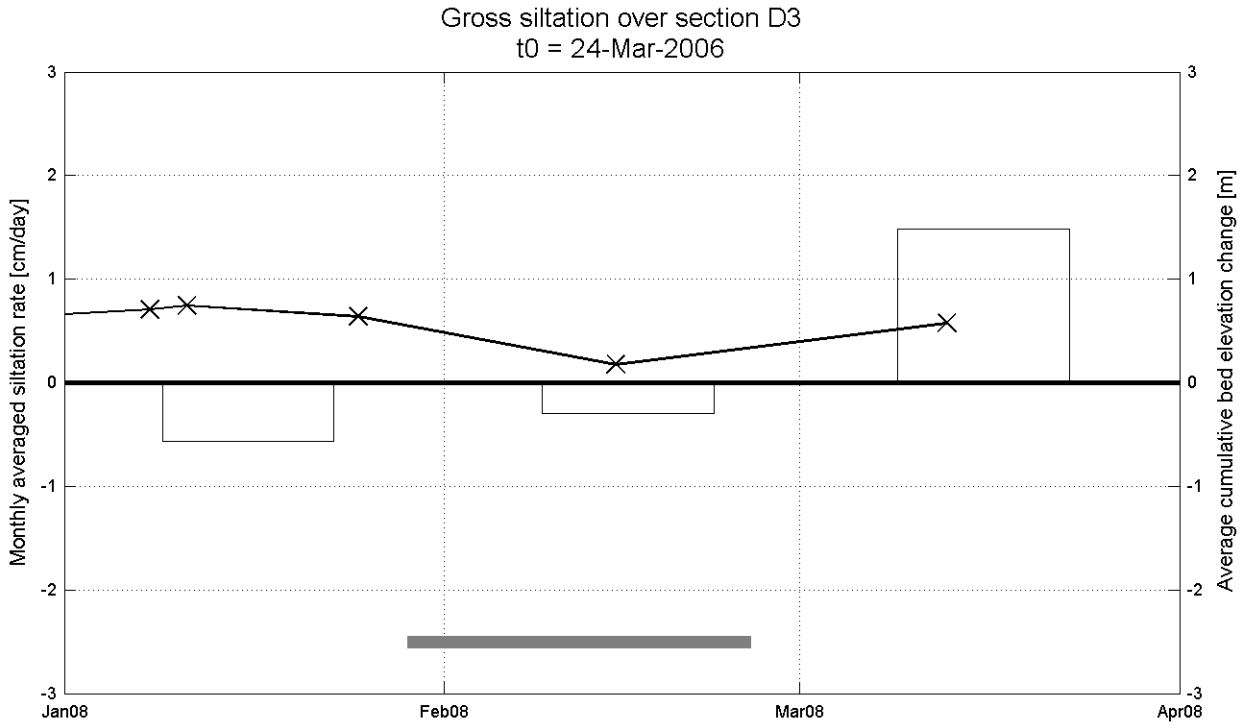
Data Processed by:

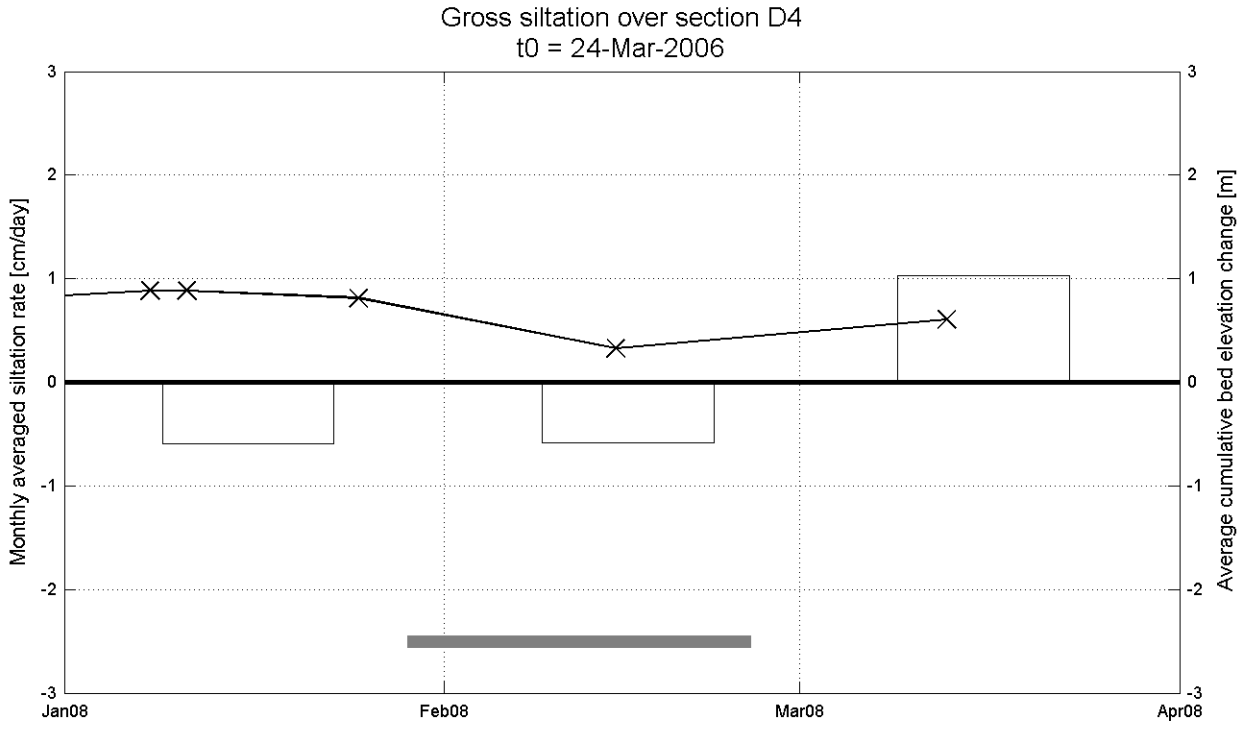
In association with :

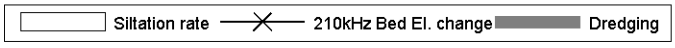
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

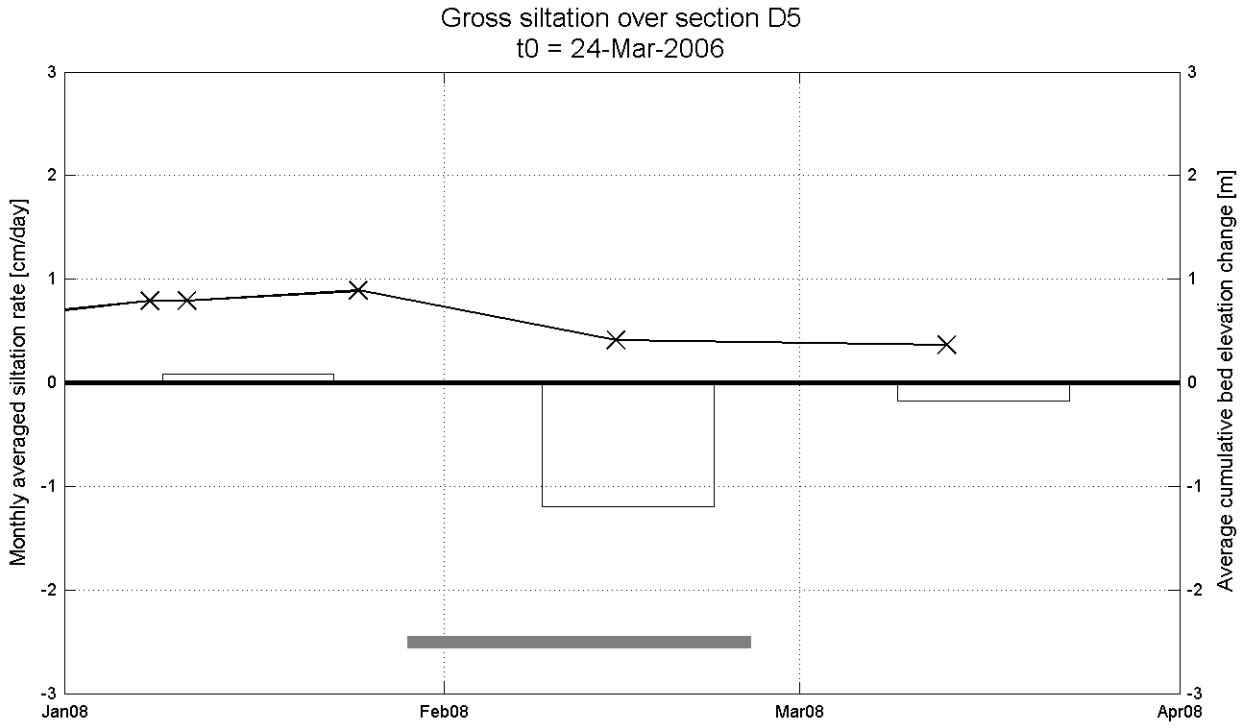
Data Processed by:

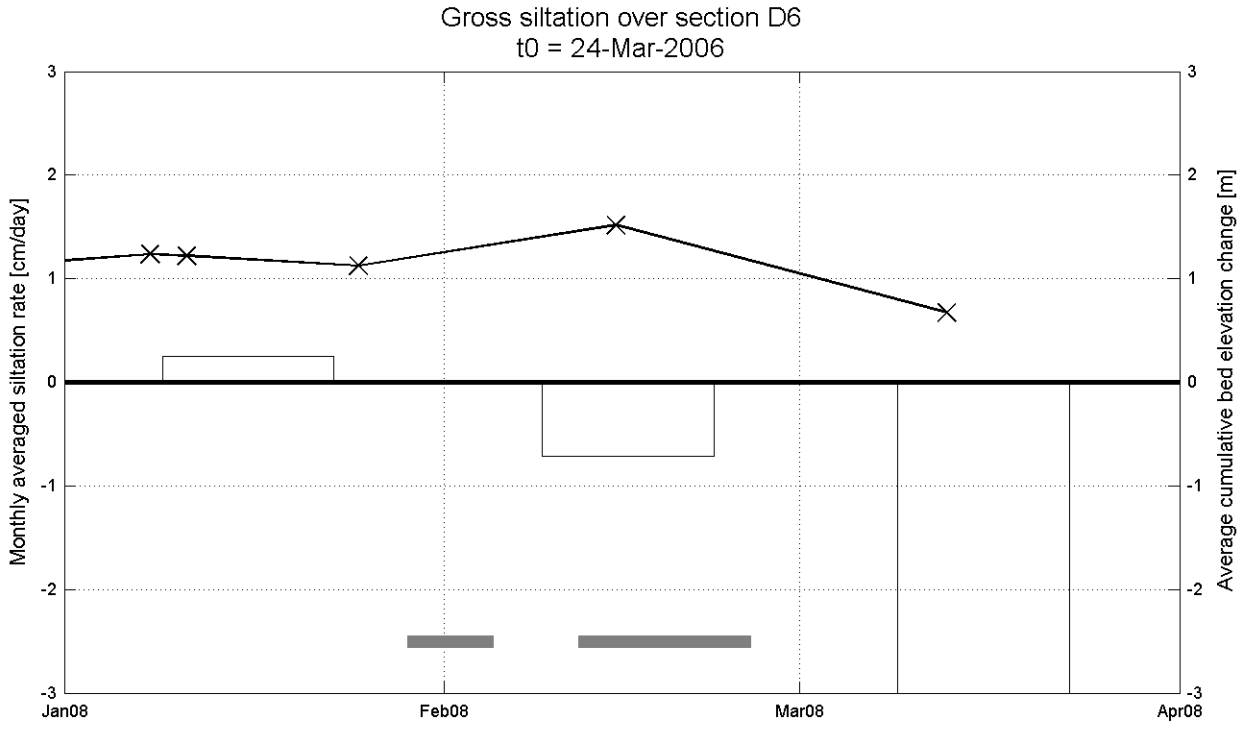
In association with :

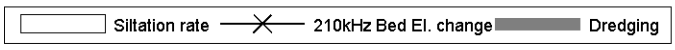
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

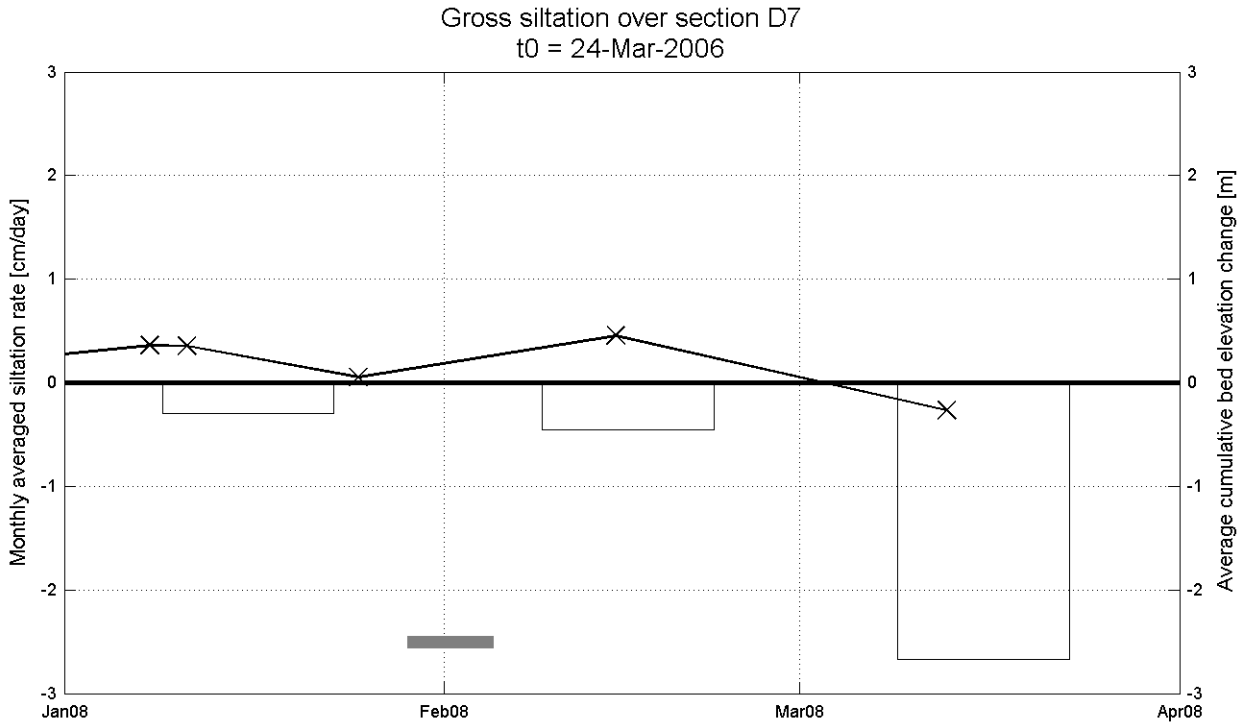
Data Processed by:

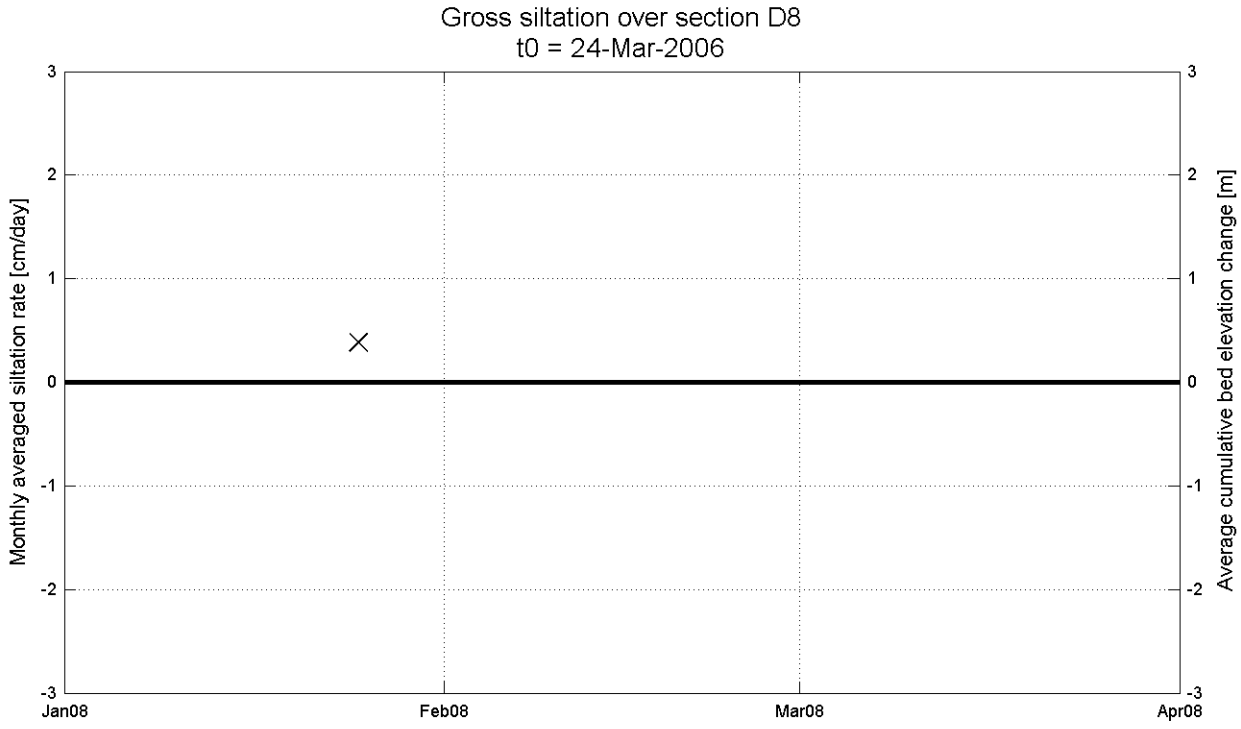
In association with :

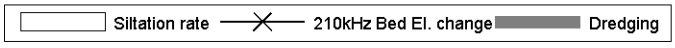
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

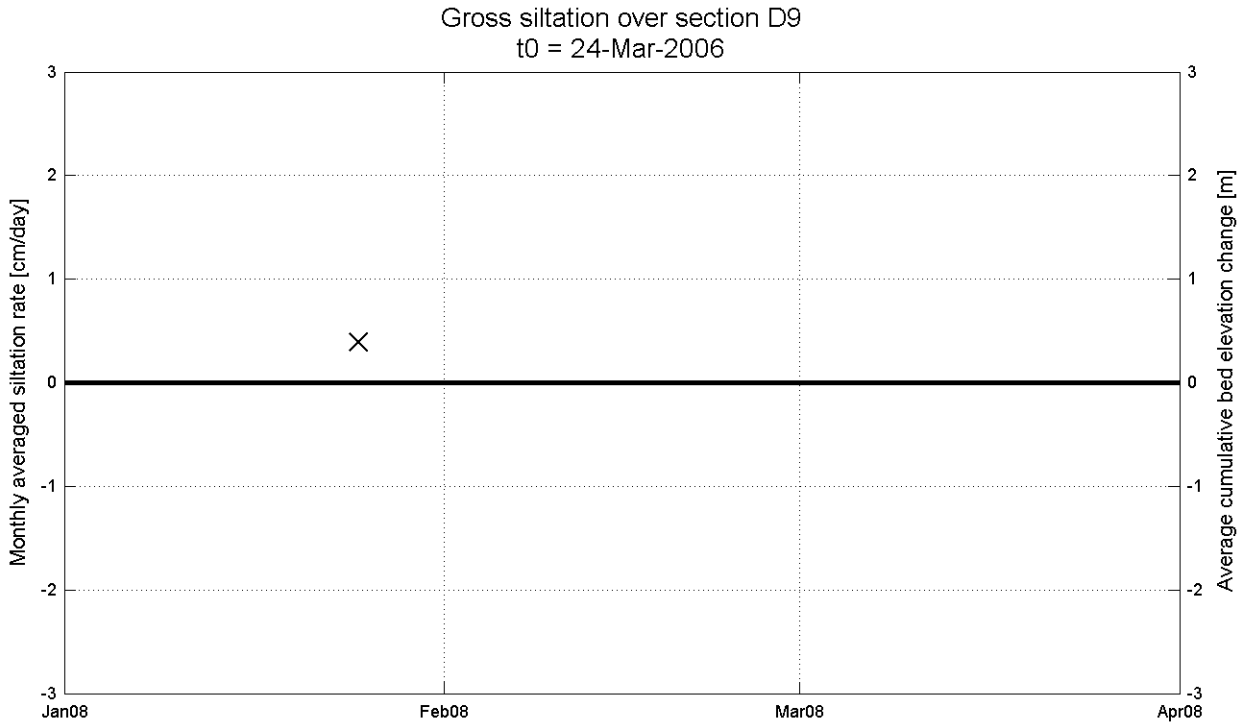
Data Processed by:

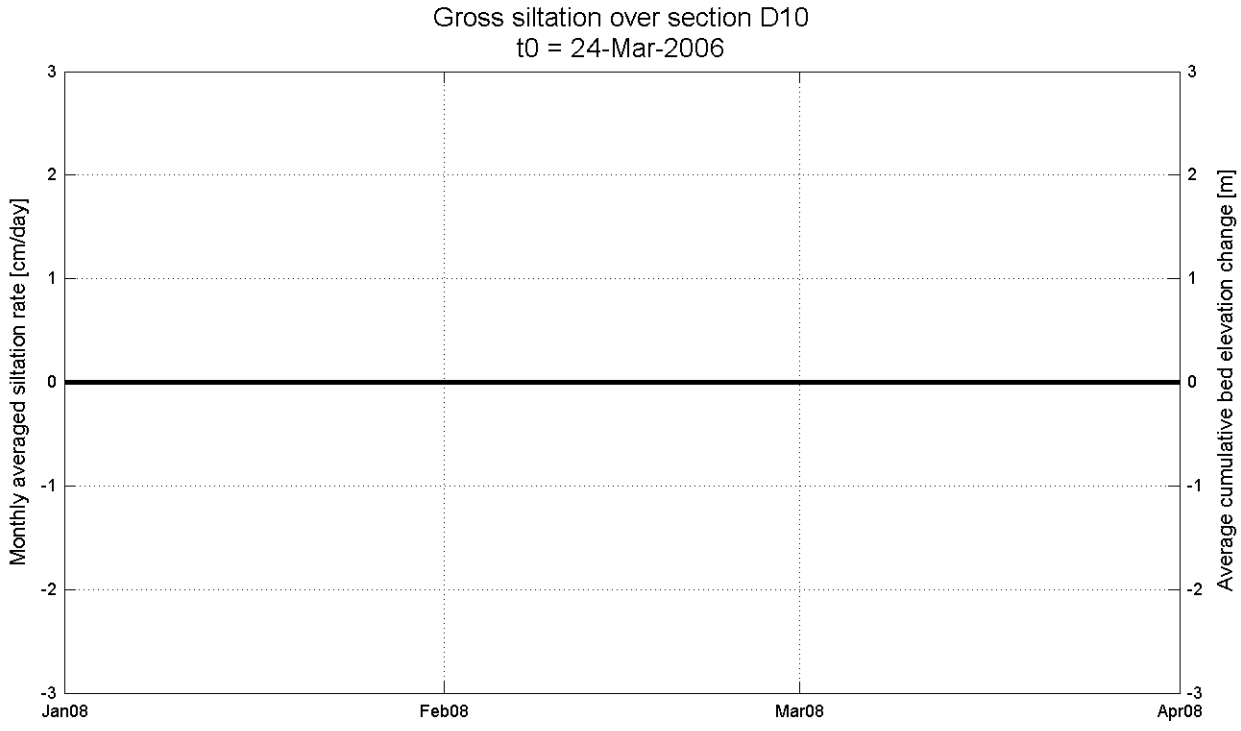
In association with :

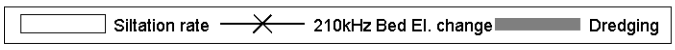
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

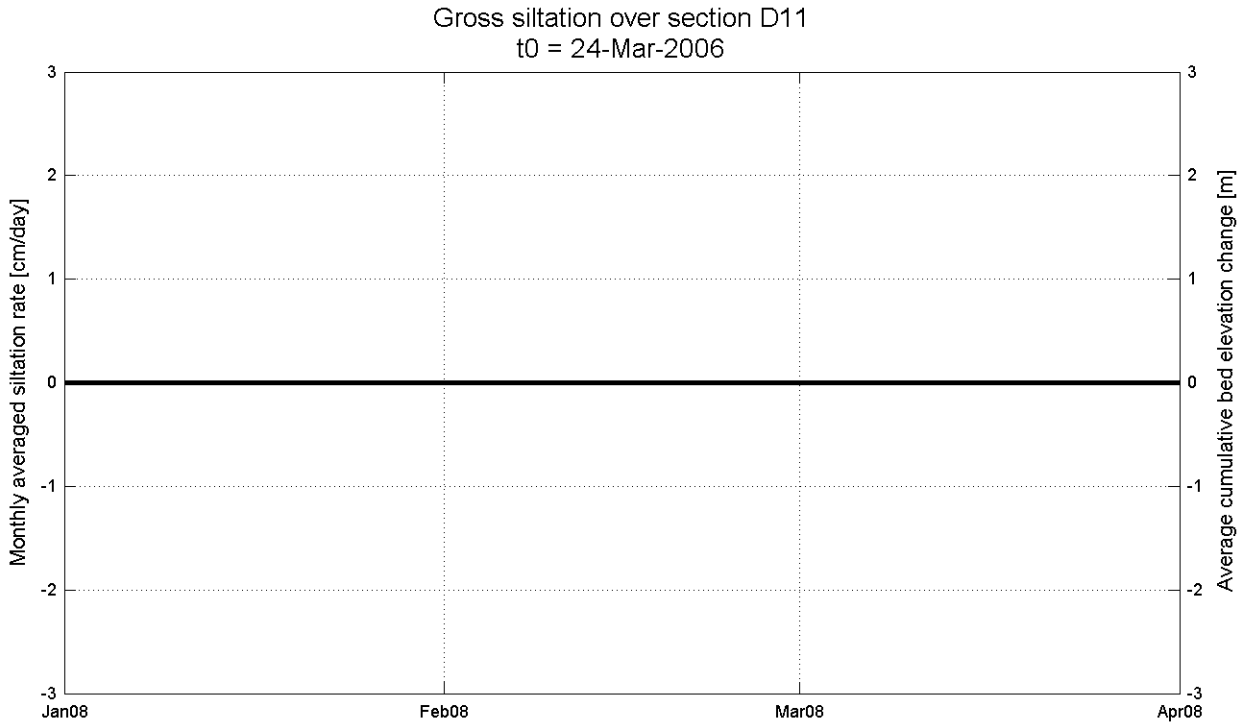
Data Processed by:

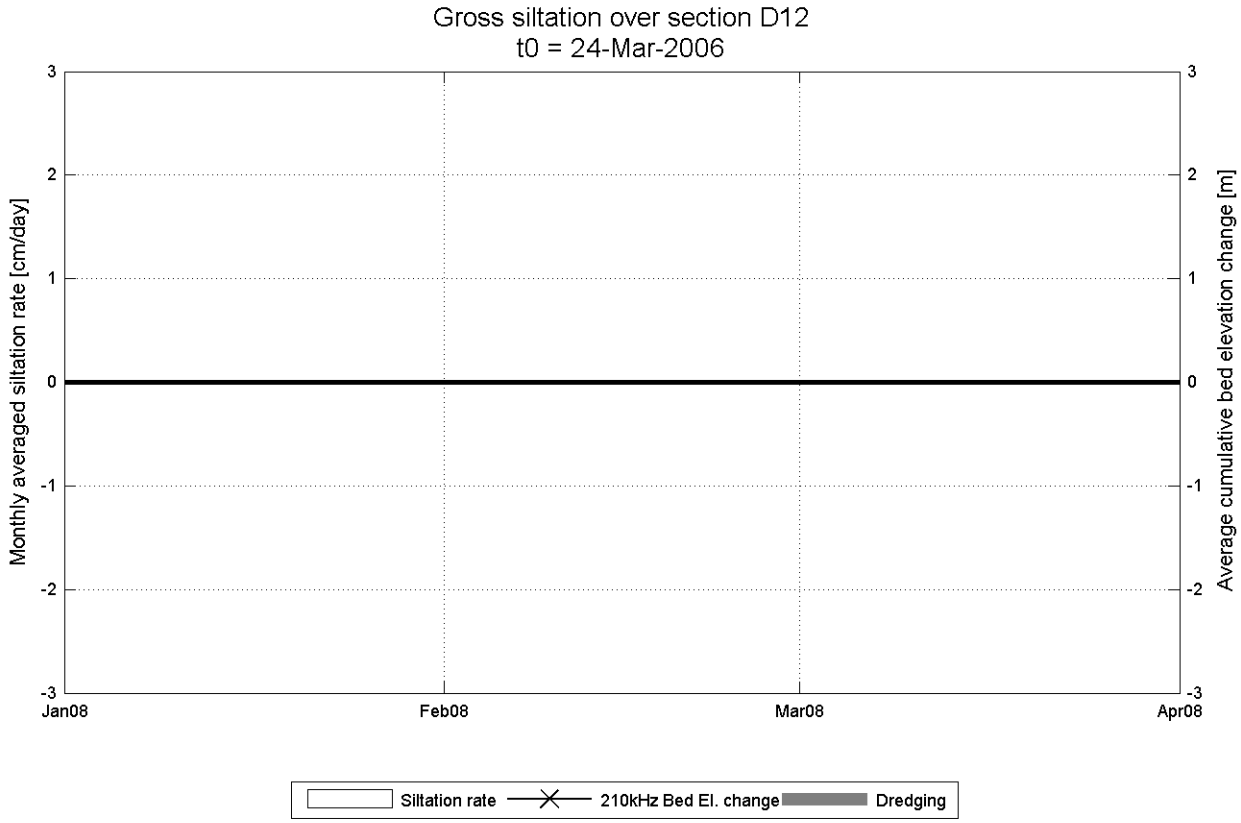
In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD





Reference level: depth sounding 24-Mar-2006

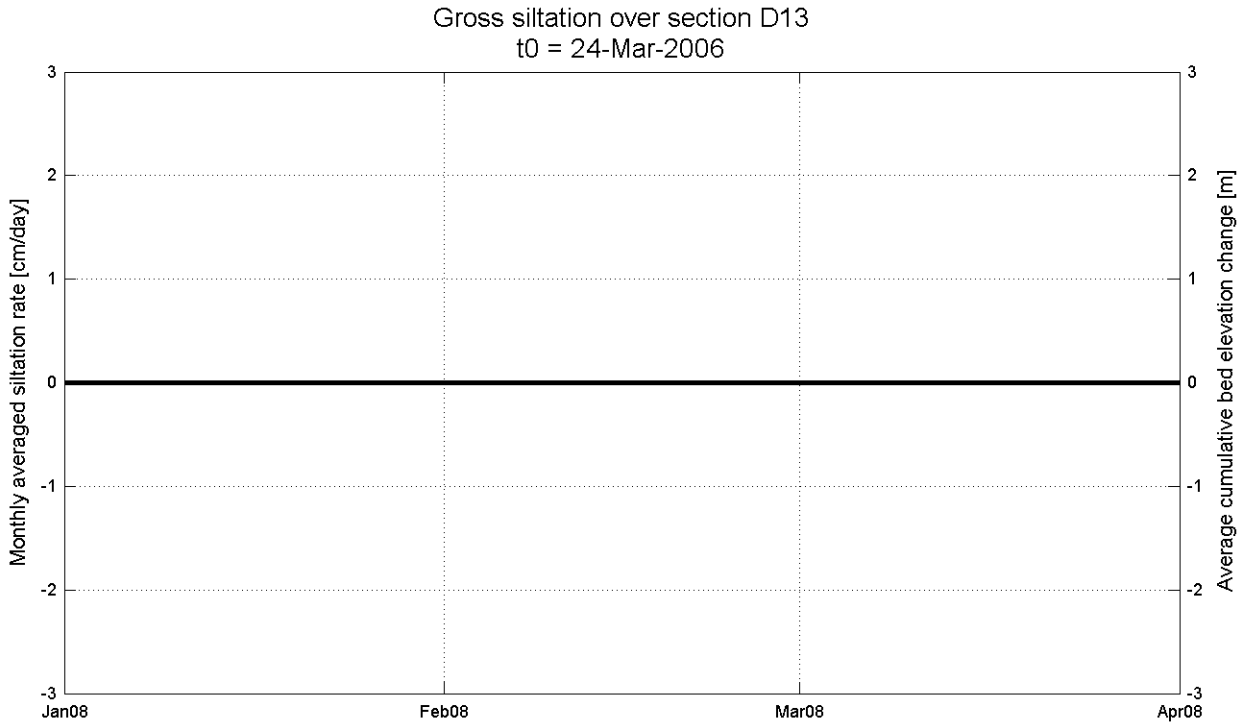
Data Processed by:

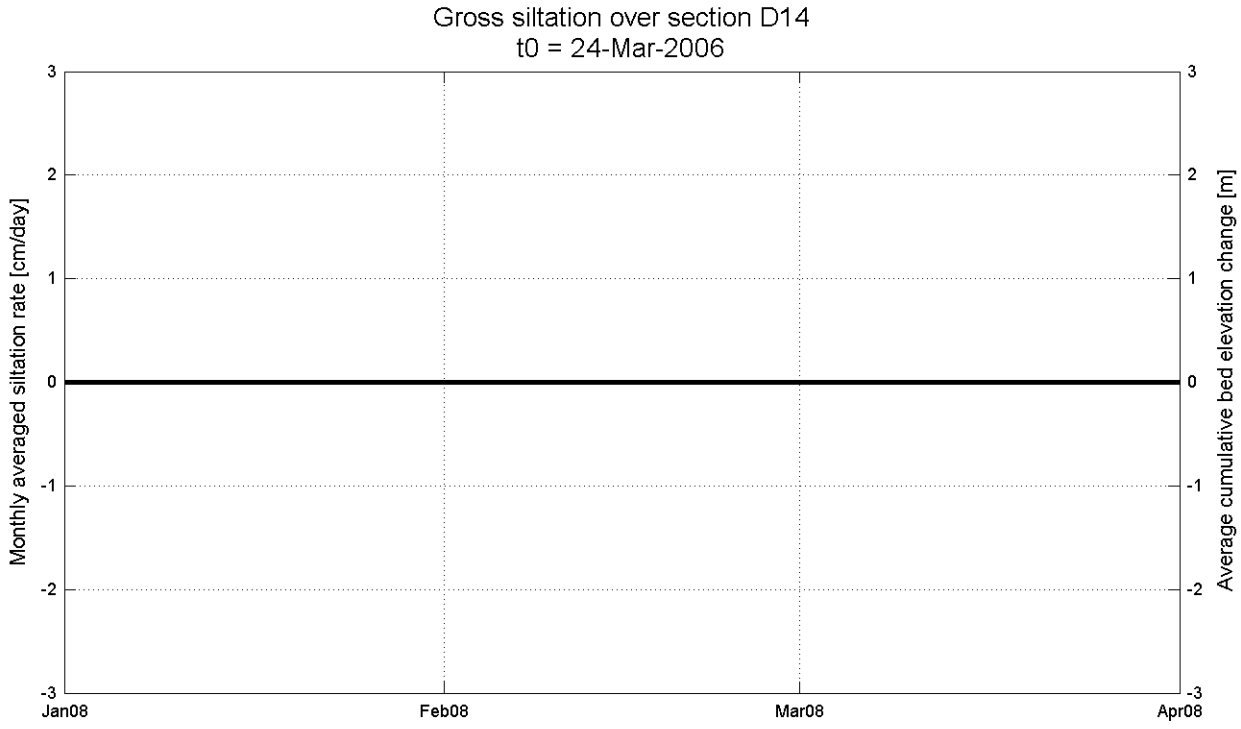
In association with :

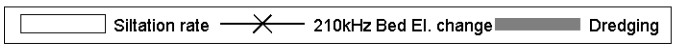
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

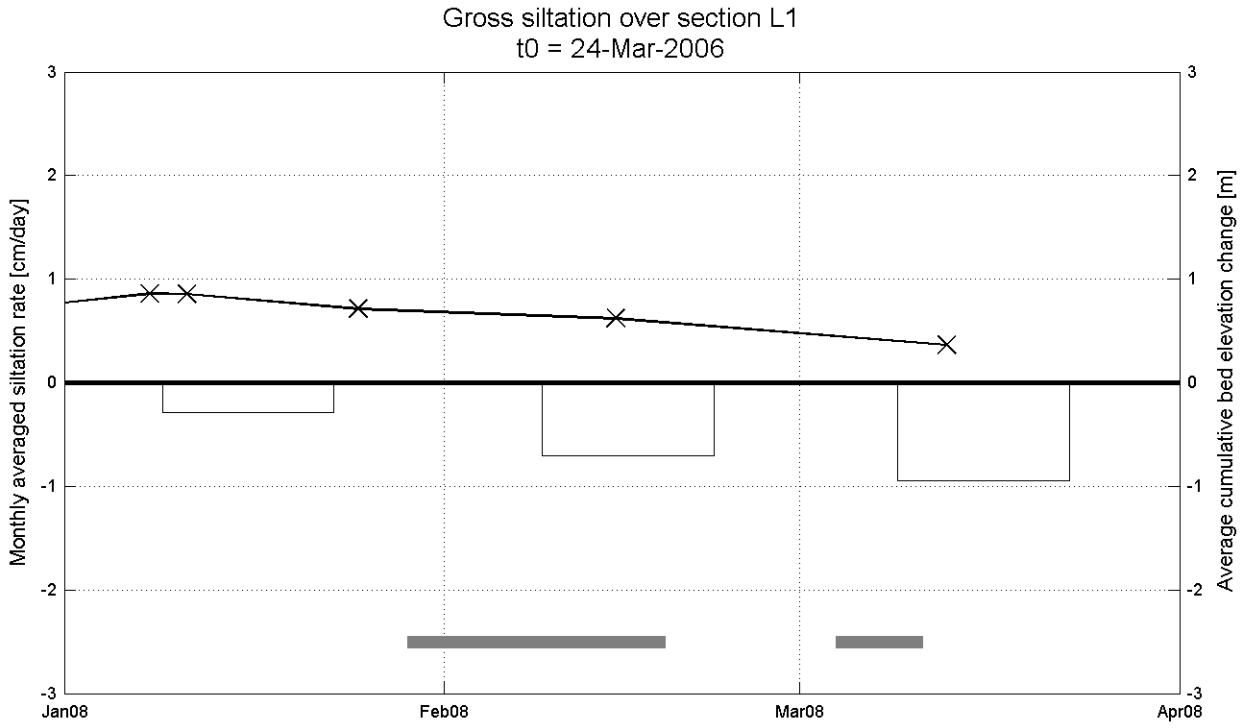
Data Processed by:

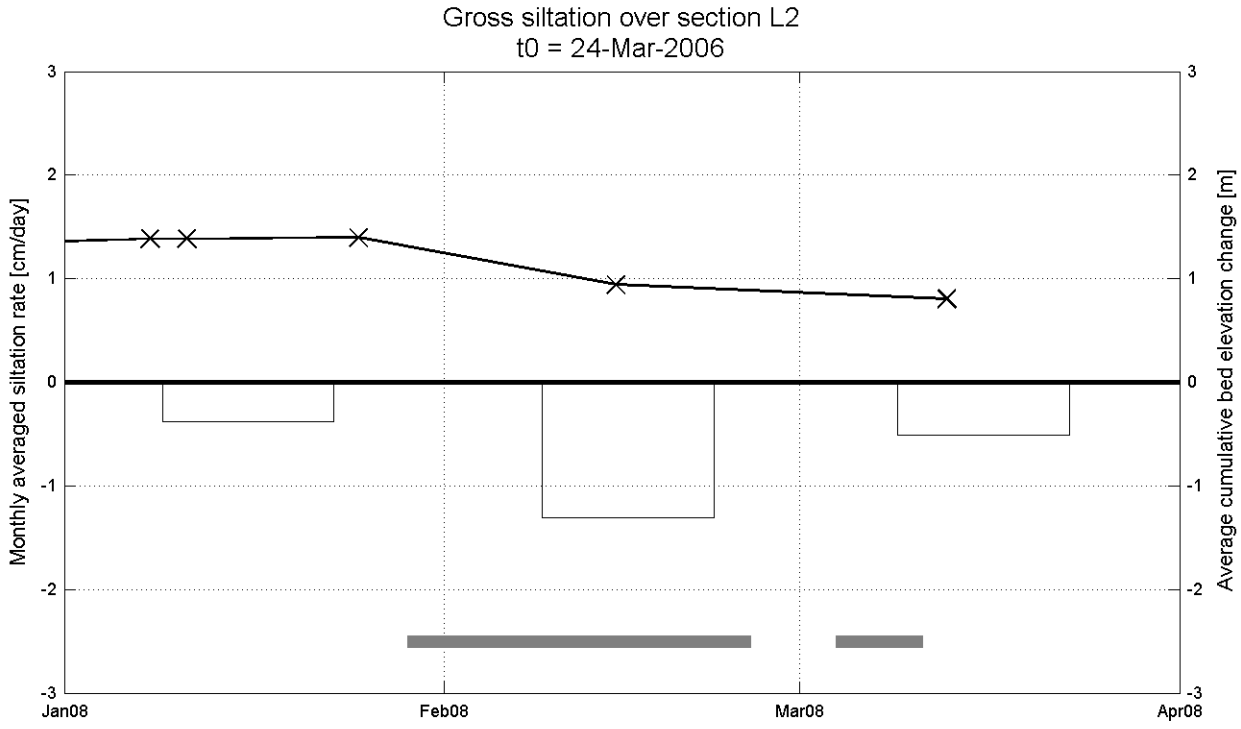
In association with :

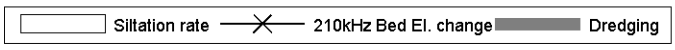
I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD







Reference level: depth sounding 24-Mar-2006

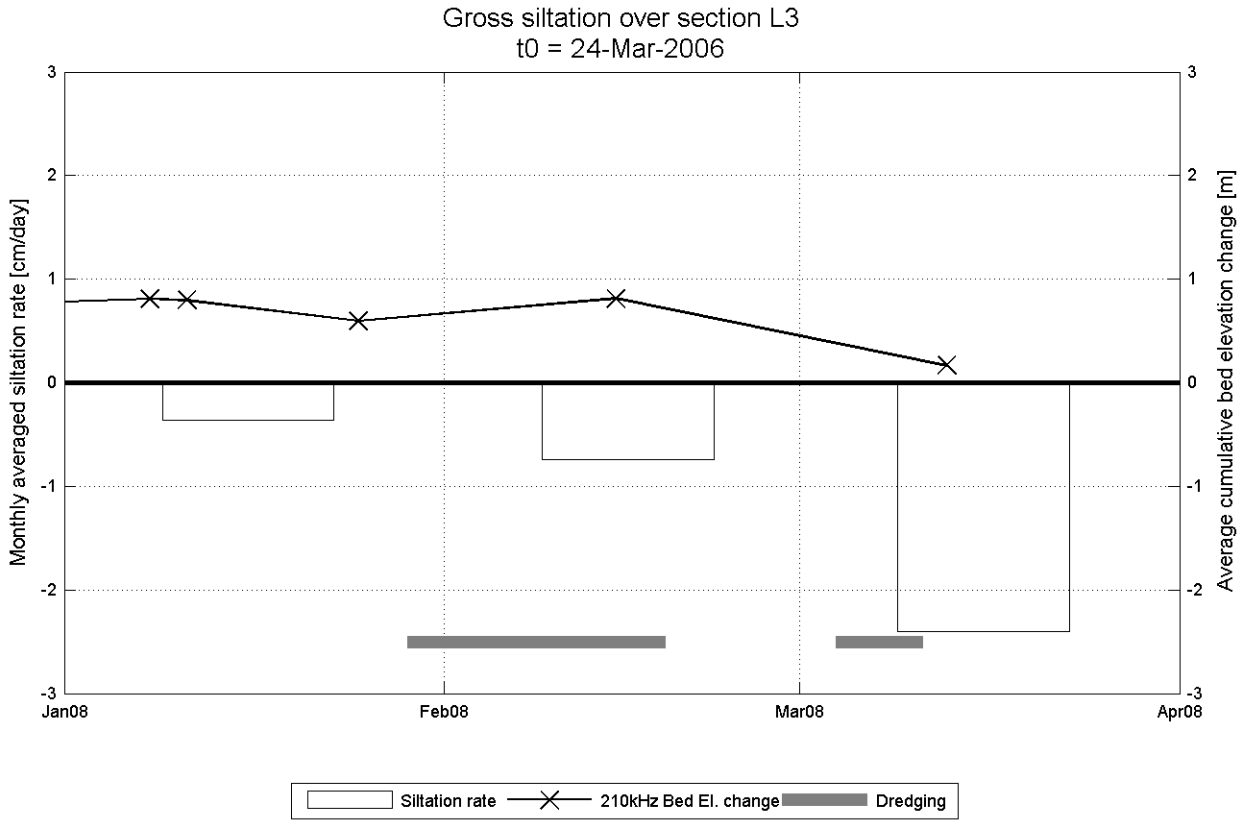
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Siltation height / monthly gross siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD



Reference level: depth sounding 24-Mar-2006

Data Processed by:

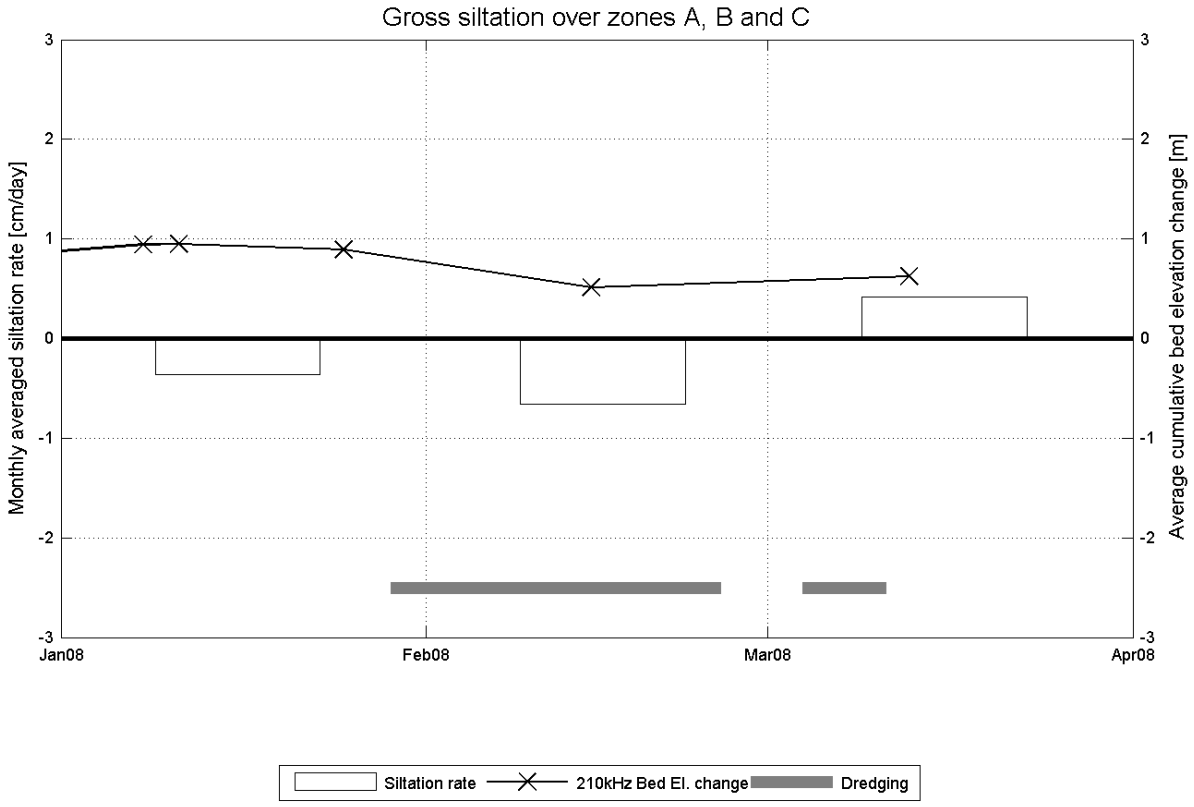
In association with :

I/RA/11283/07.084/MSA

C.4 Siltation rate complete Deurganckdok

Long-term monitoring siltation Deurganckdok

Siltation height / monthly siltation rate	Equipment(s): 210kHz depth sounder
	Location: DGD



Gross siltation for zones 3A/3B/4A/4B/5A/5B
Reference level: depth sounding 24-Mar-2006

Data Processed by:

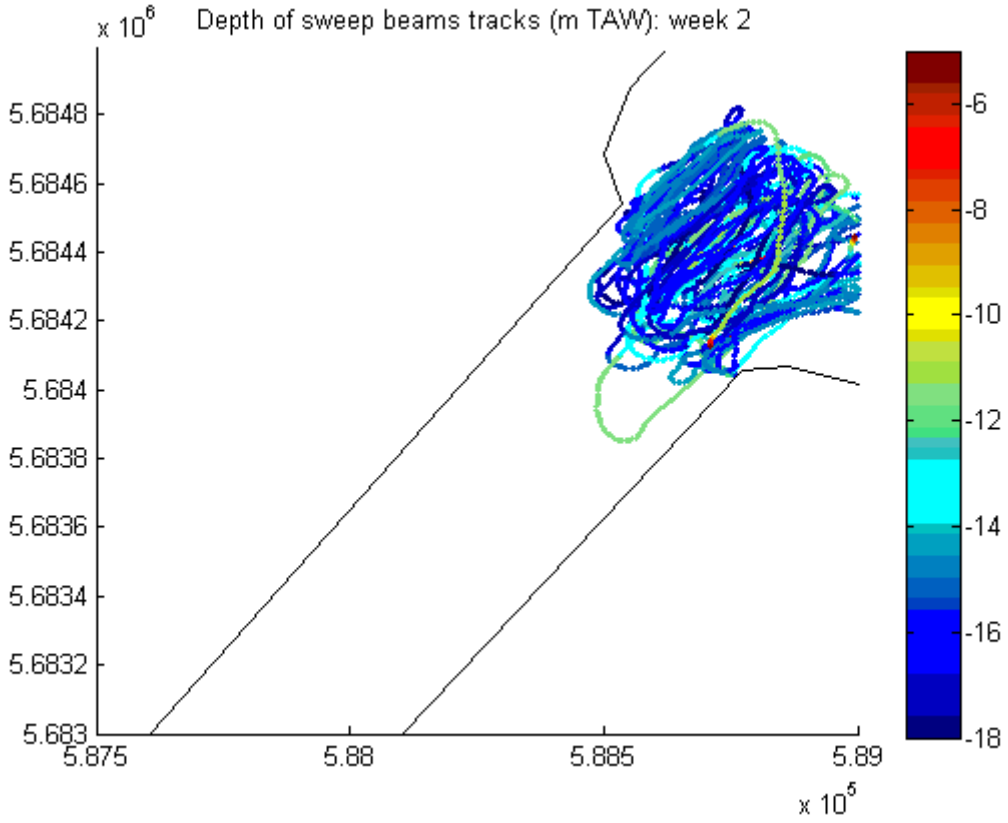
In association with :

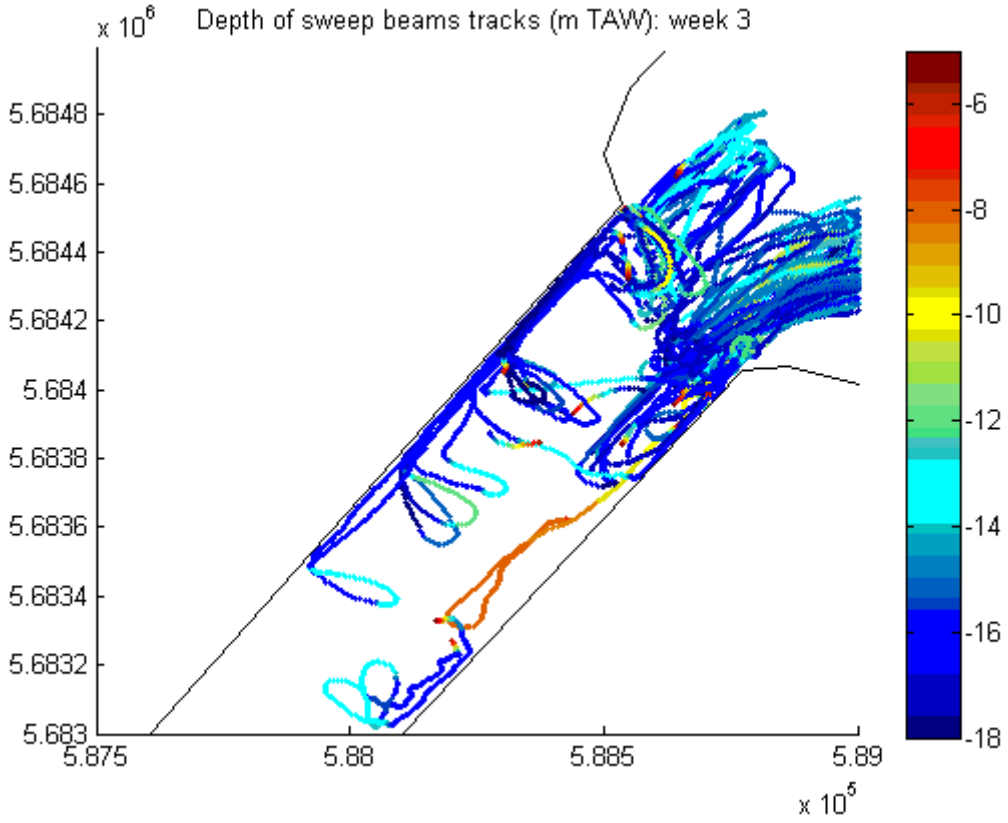
I/RA/11283/07.084/MSA

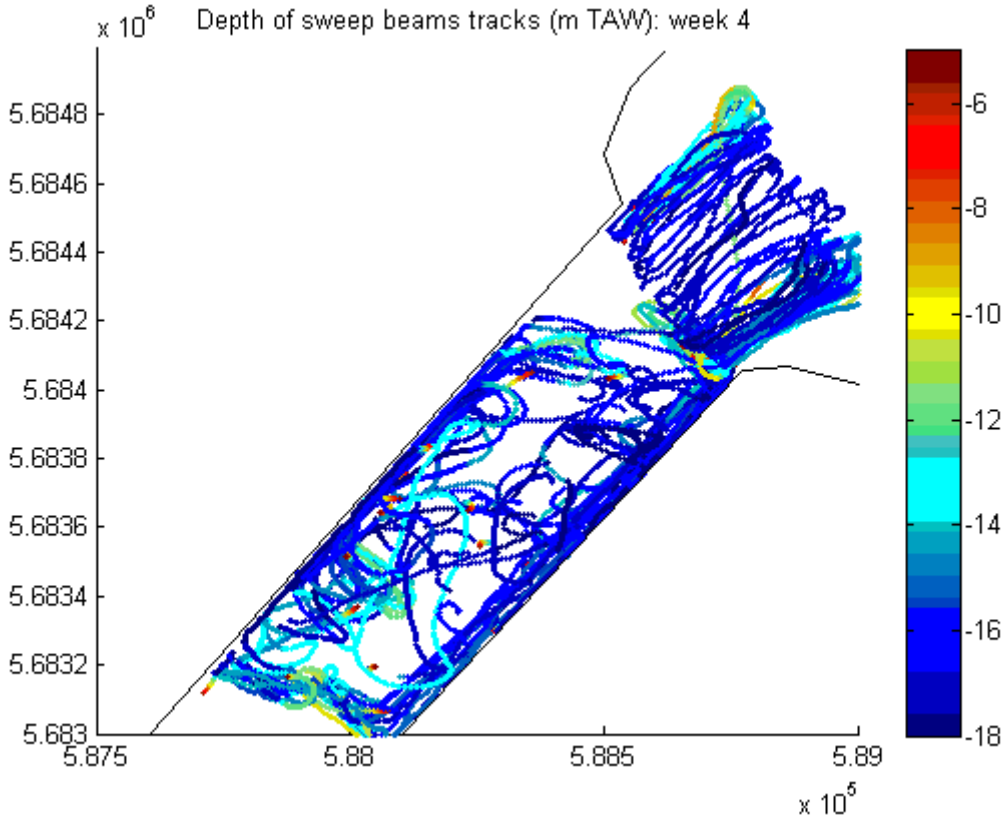
APPENDIX D.

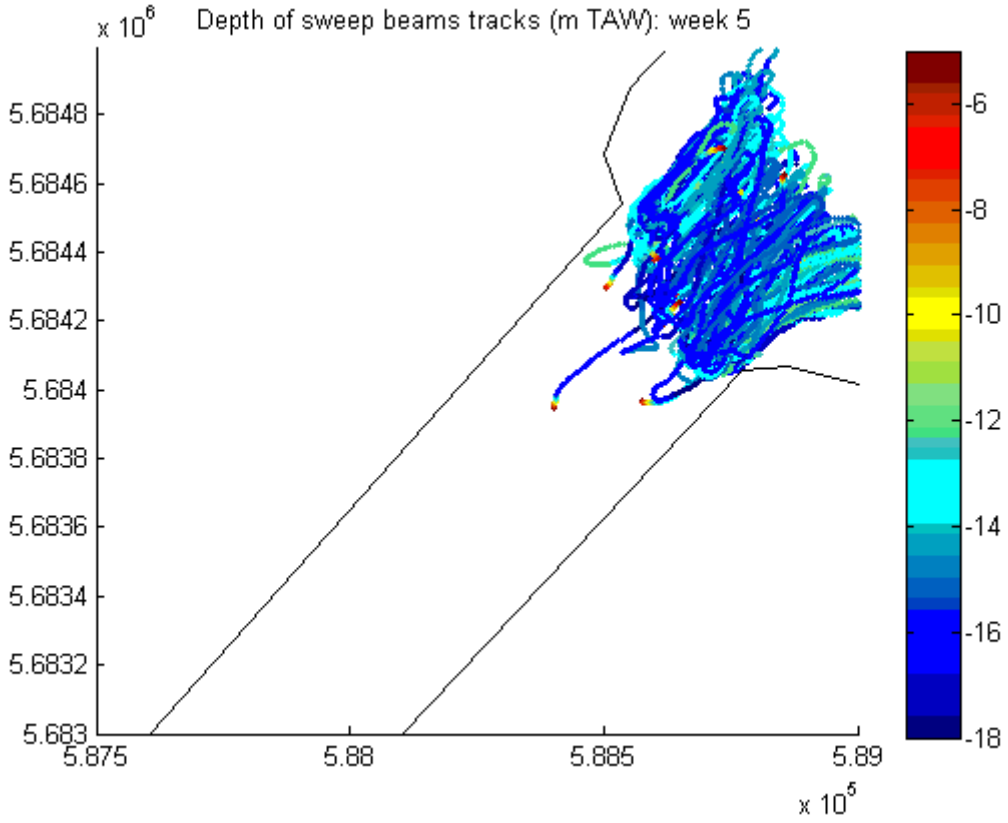
SWEEP BEAM TRACKS

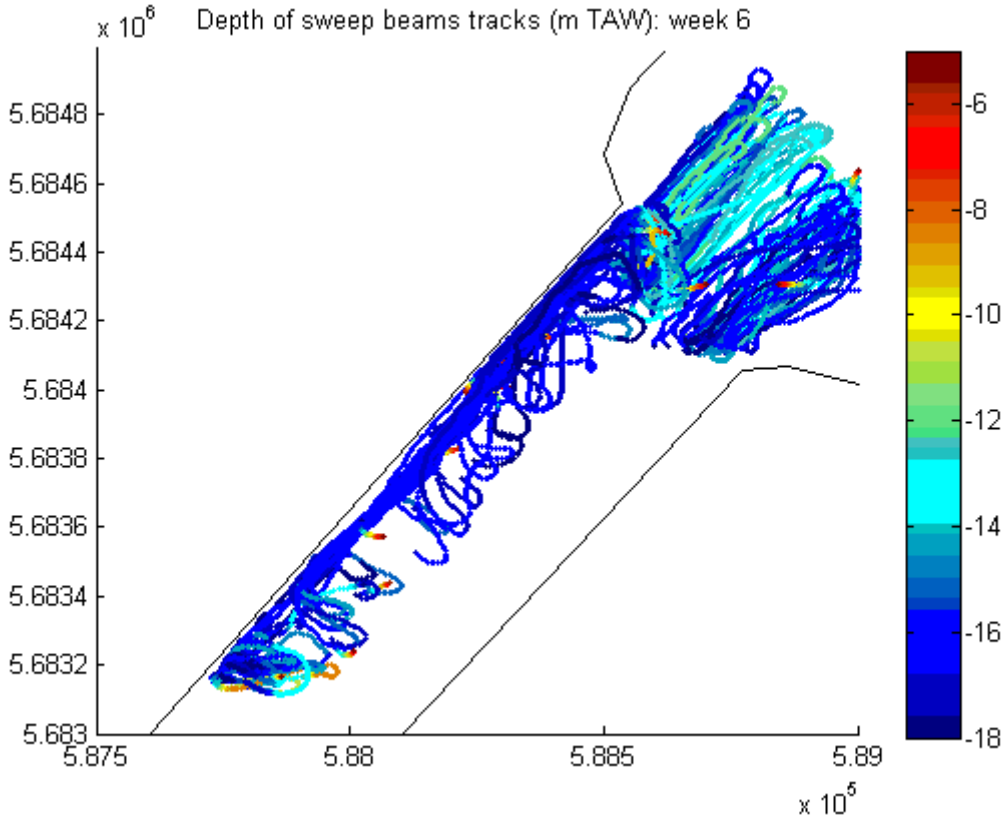
D.1 Depth of sweep beam tracks

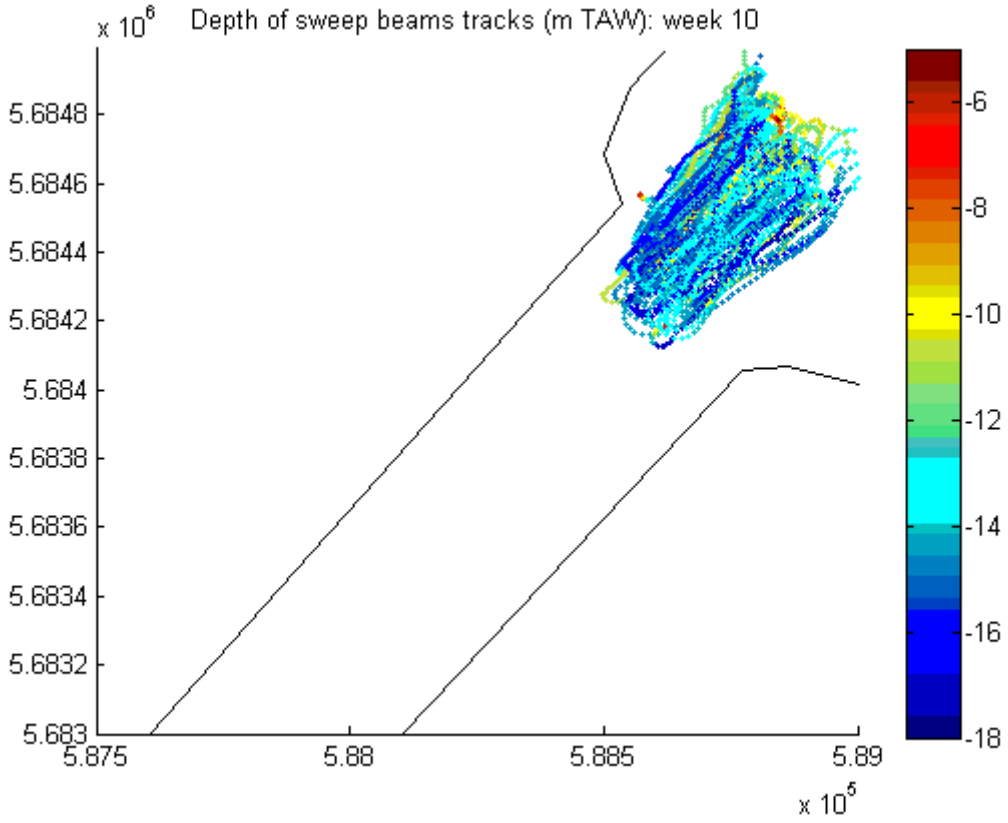

x 10^6
Depth of sweep beams tracks (m TAW): week 2
5.6848
5.6846
5.6844
5.6842
5.684
5.6838
5.6836
5.6834
5.6832
5.683
5.875
5.88
5.885
5.89
x 10^5
-6
-8
-10
-12
-14
-16
-18


x 10^6
Depth of sweep beams tracks (m TAW): week 3
5.6848
5.6846
5.6844
5.6842
5.684
5.6838
5.6836
5.6834
5.6832
5.683
5.875
5.88
5.885
5.89
x 10^5
-6
-8
-10
-12
-14
-16
-18


x 10^6
Depth of sweep beams tracks (m TAW): week 4
5.6848
5.6846
5.6844
5.6842
5.684
5.6838
5.6836
5.6834
5.6832
5.683
5.875
5.88
5.885
5.89
x 10^5
-6
-8
-10
-12
-14
-16
-18

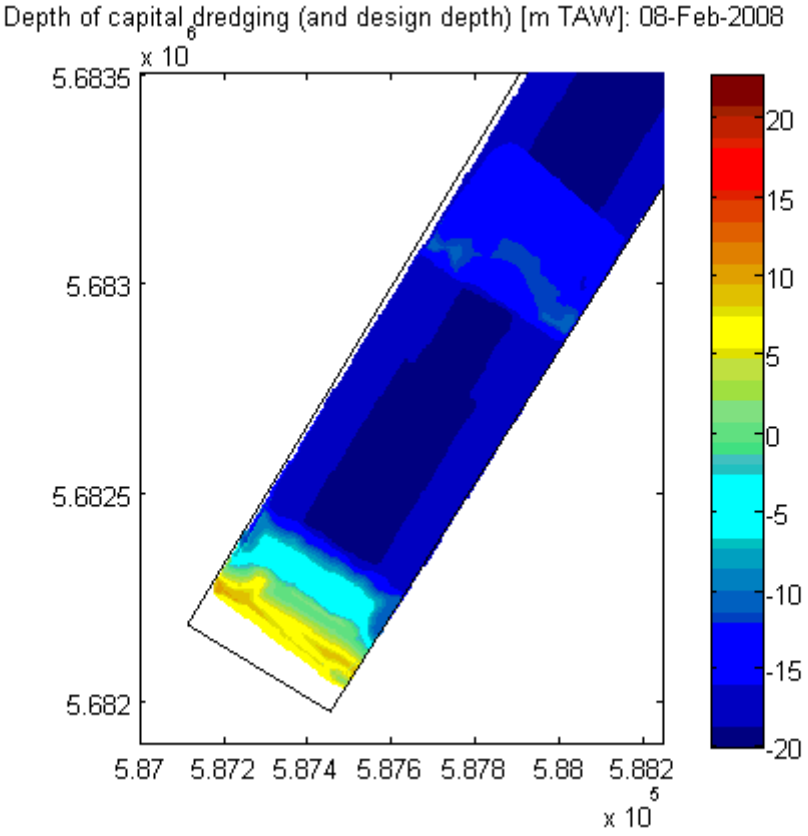

x 10^6
Depth of sweep beams tracks (m TAW): week 5
5.6848
5.6846
5.6844
5.6842
5.684
5.6838
5.6836
5.6834
5.6832
5.683
5.875
5.88
5.885
5.89
x 10^5
-6
-8
-10
-12
-14
-16
-18


x 10^6
Depth of sweep beams tracks (m TAW): week 6
5.6848
5.6846
5.6844
5.6842
5.684
5.6838
5.6836
5.6834
5.6832
5.683
5.875
5.88
5.885
5.89
x 10^5
-6
-8
-10
-12
-14
-16
-18


x 10^6
Depth of sweep beams tracks (m TAW): week 10
5.6848
5.6846
5.6844
5.6842
5.684
5.6838
5.6836
5.6834
5.6832
5.683
5.875
5.88
5.885
5.89
x 10^5
-6
-8
-10
-12
-14
-16
-18

APPENDIX E.

CAPITAL DREDGING PROGRESS


Depth of capital dredging (and design depth) [m TAW]: 08-Feb-2008
x 10^6
5.6835
5.683
5.6825
5.682
5.87
5.872
5.874
5.876
5.878
5.88
5.882
x 10^5
20
15
10
5
0
-5
-10
-15
-20

APPENDIX F.

DEPTH OF WATER-BED INTERFACE AND EQUAL DENSITY LAYERS

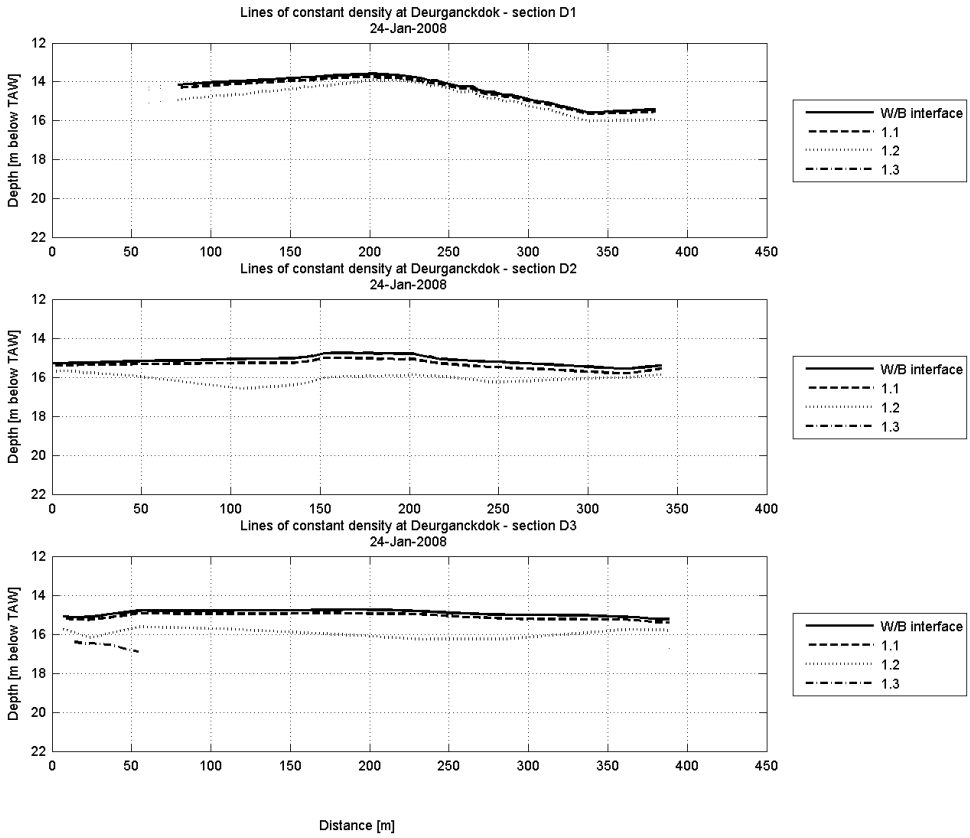
APPENDIX G.

DEPTH OF PLANES OF CONSTANT DENSITY

G.1 Measurements January 24th, 2008

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



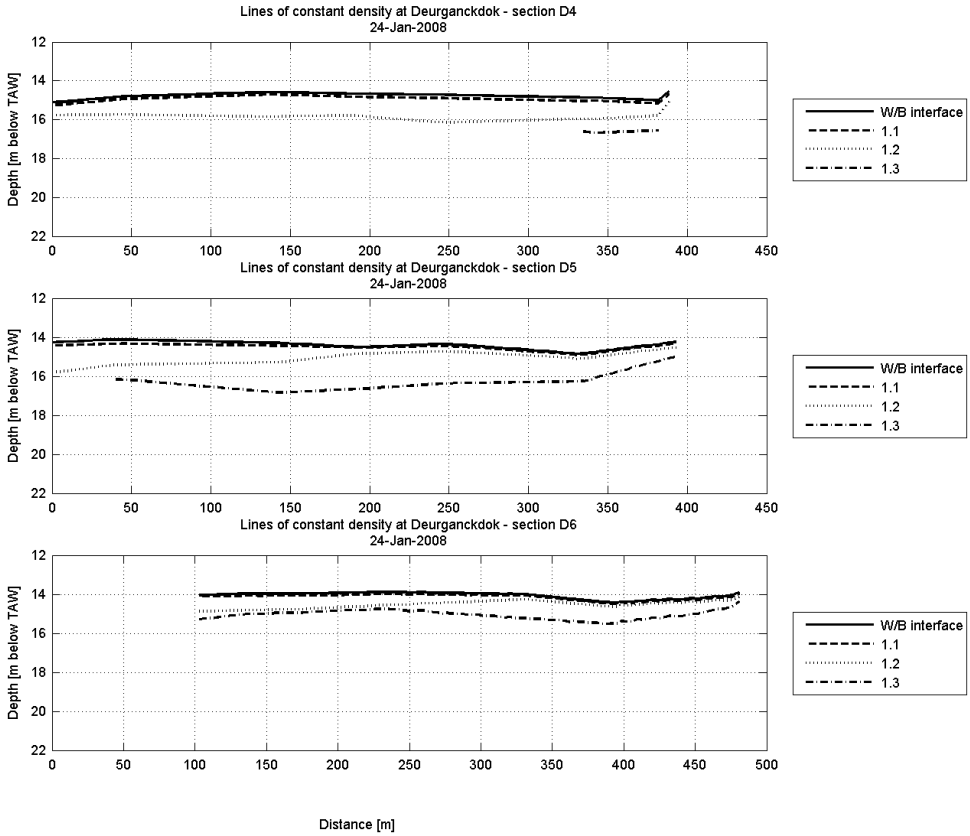
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



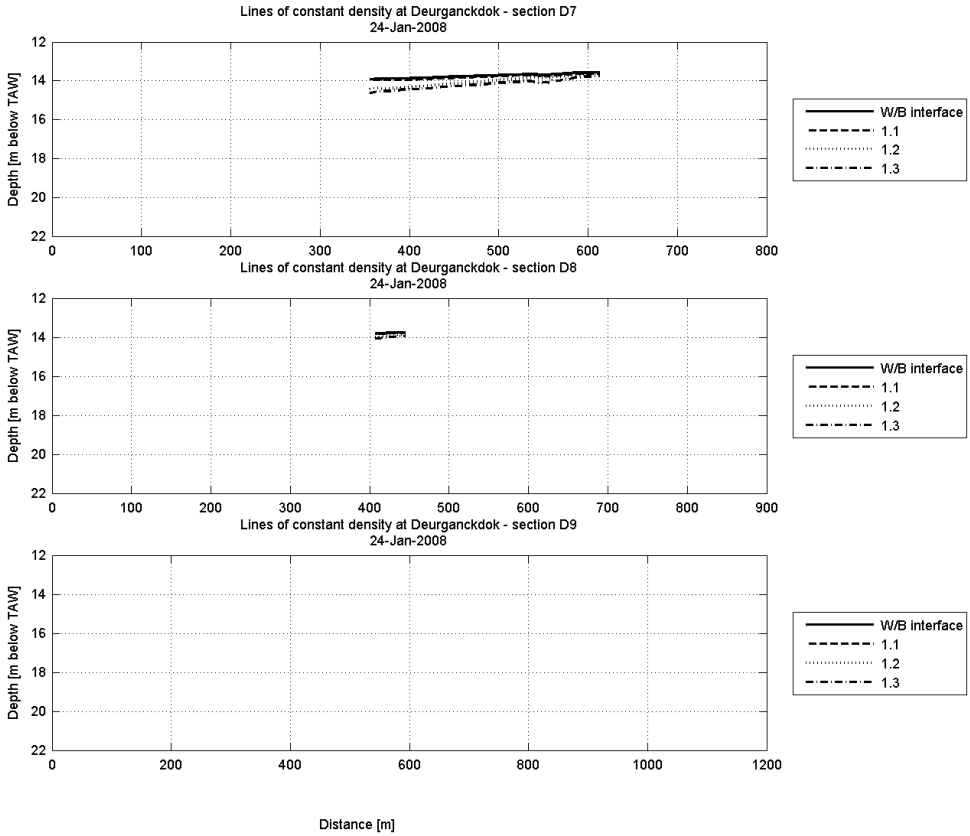
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



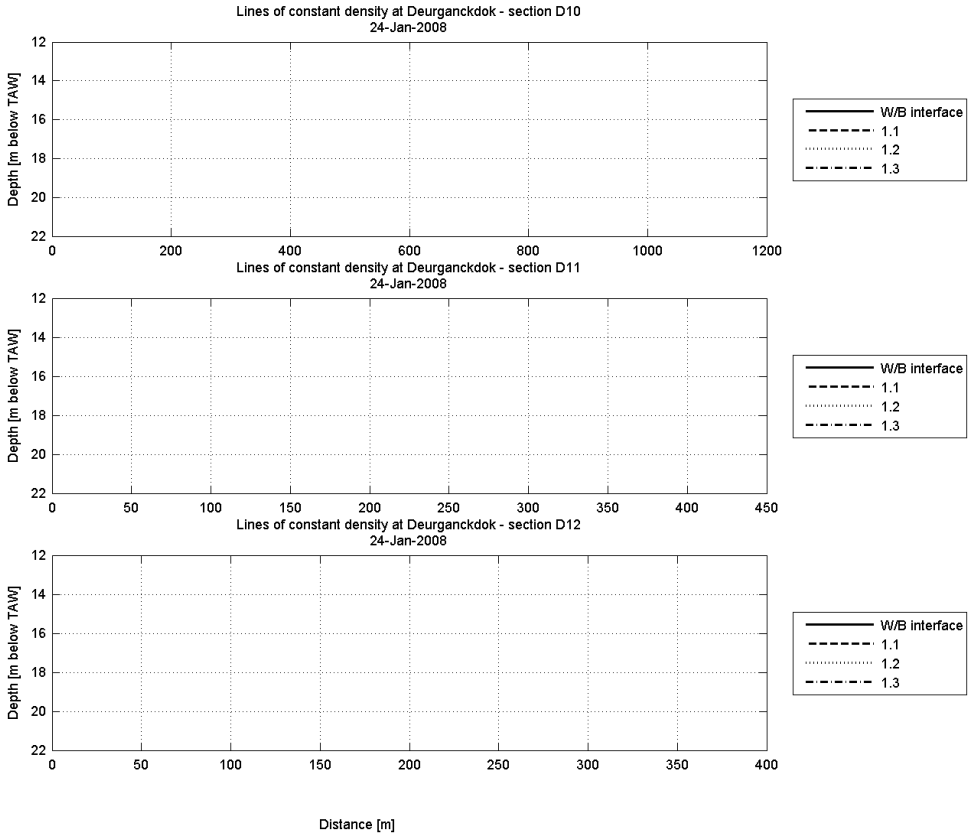
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



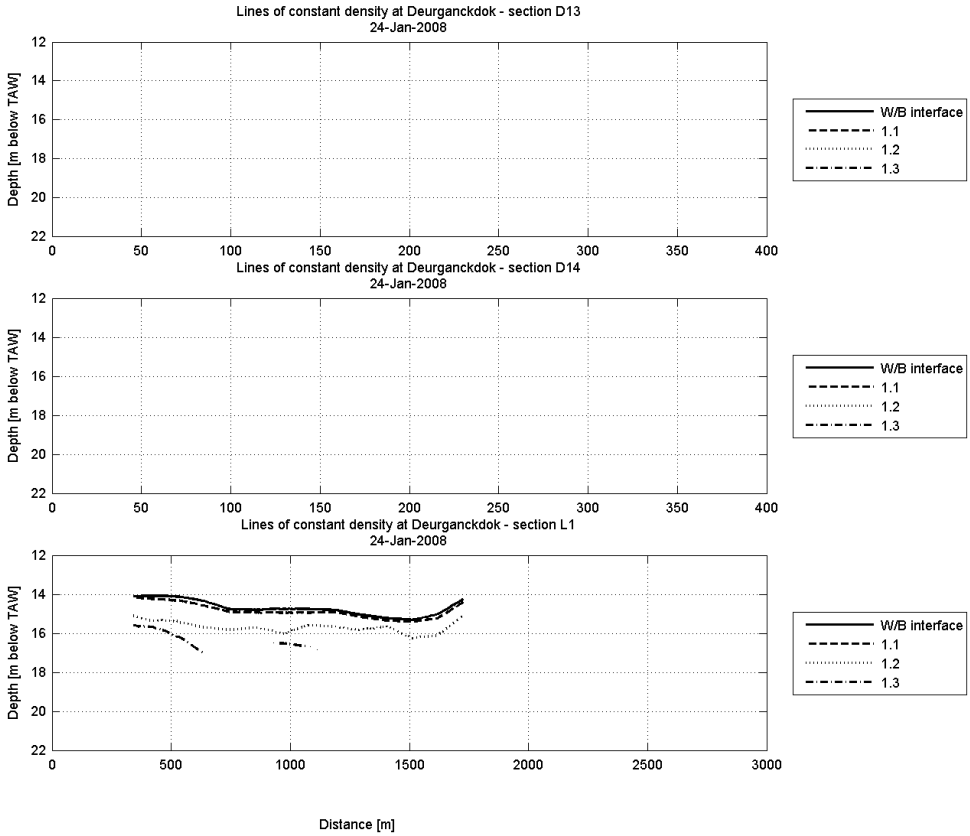
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



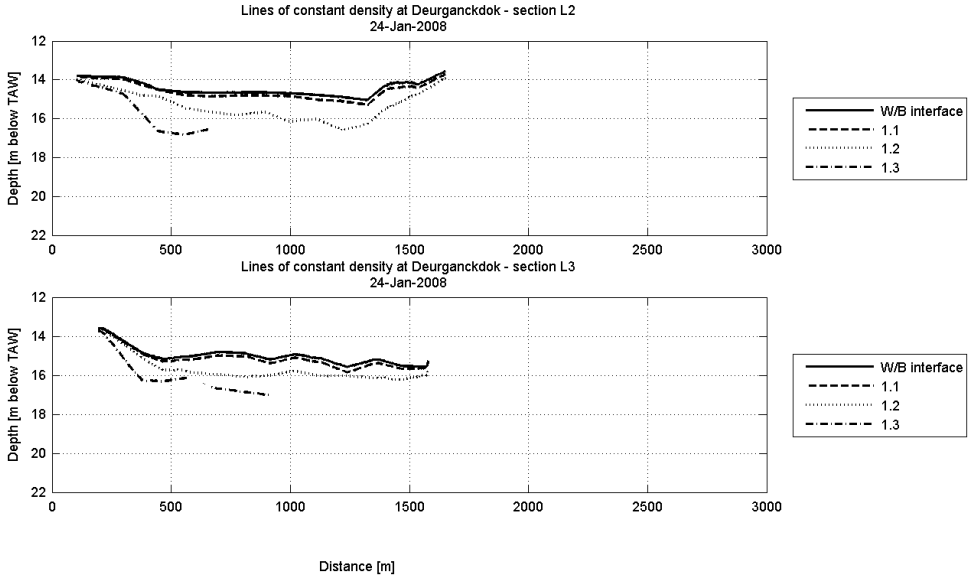
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



Data Processed by:

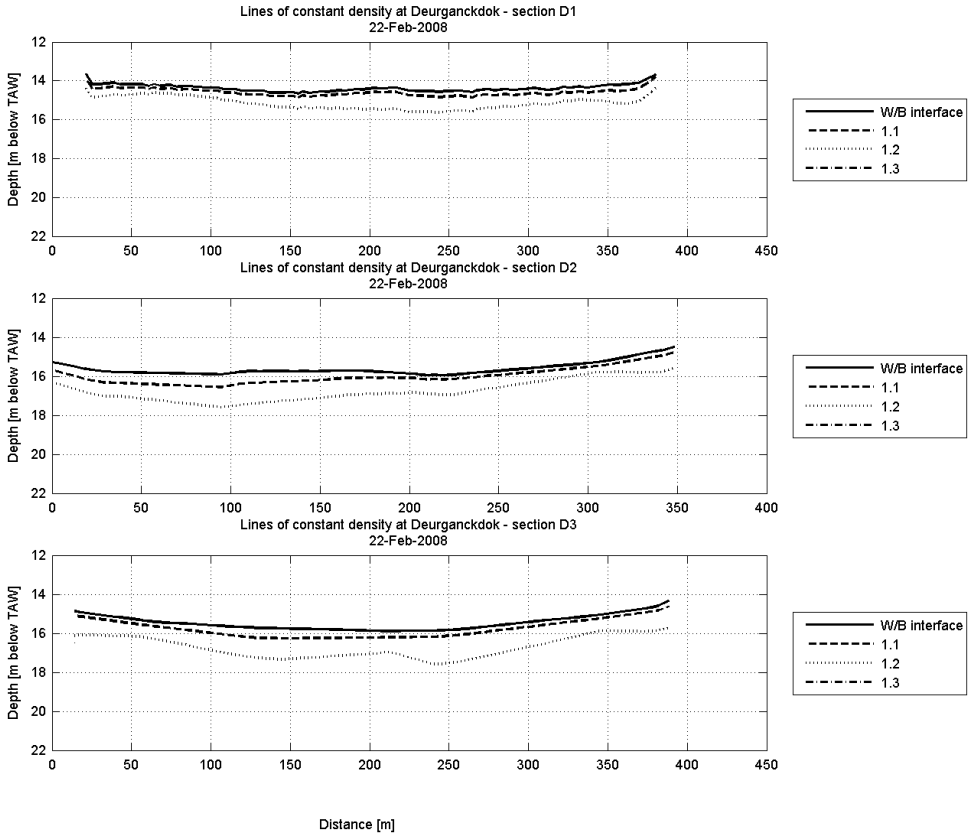
In association with :

I/RA/11283/07.084/MSA

G.2 Measurements February 22nd, 2008

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



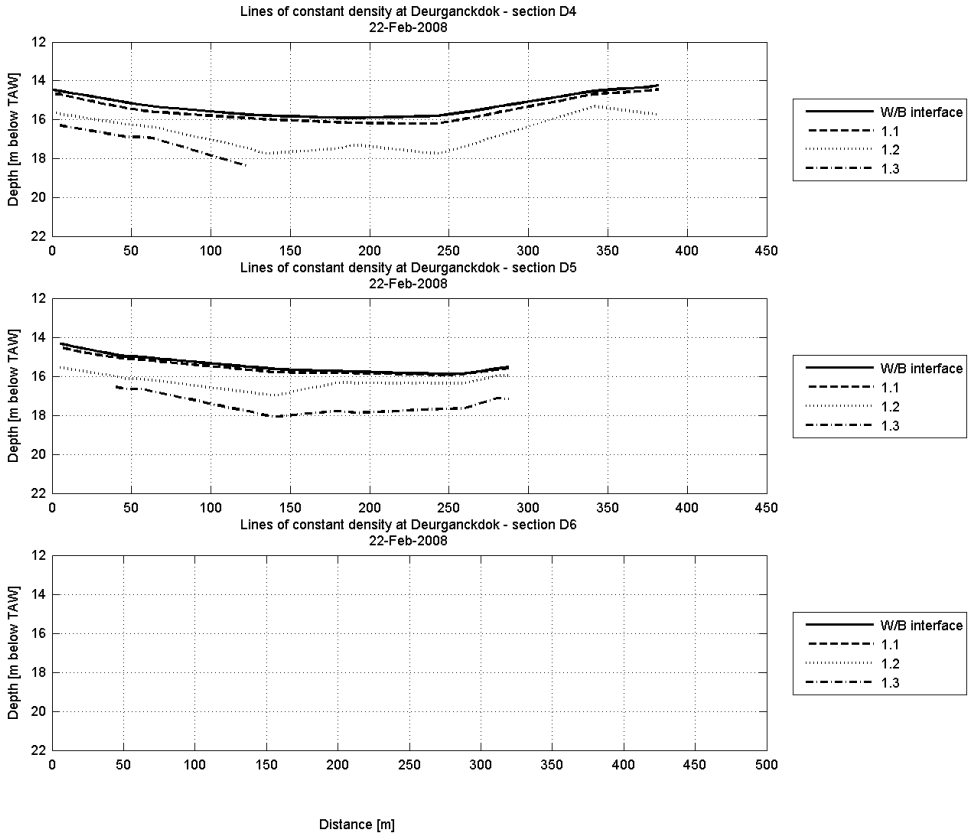
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



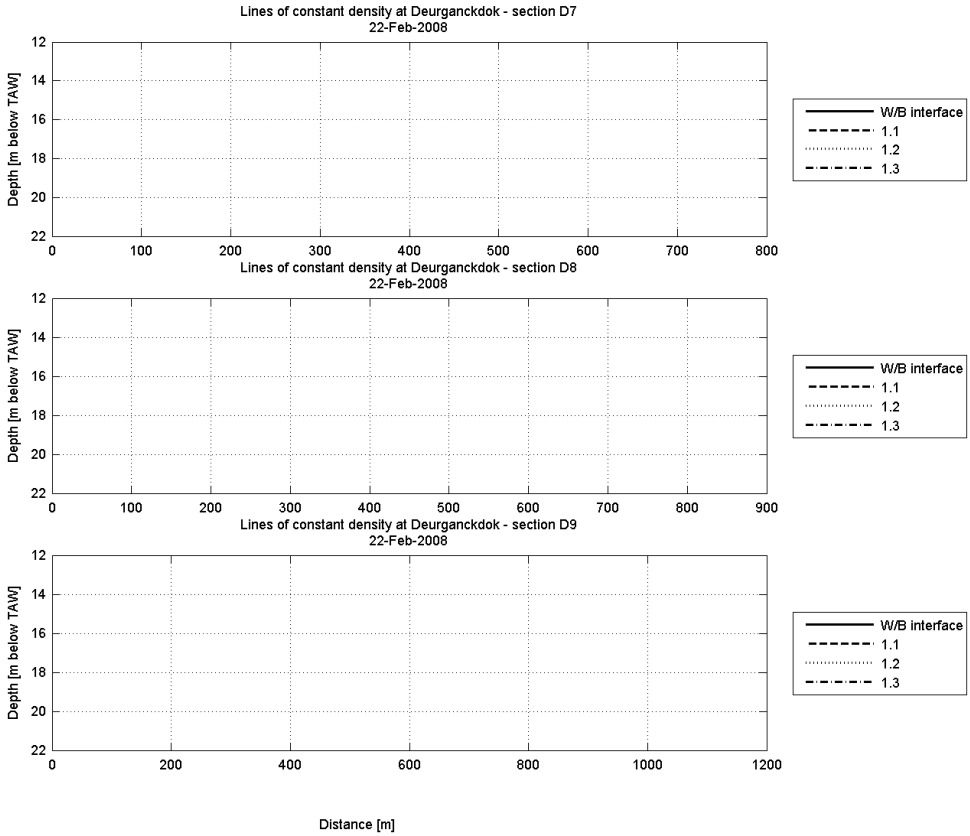
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



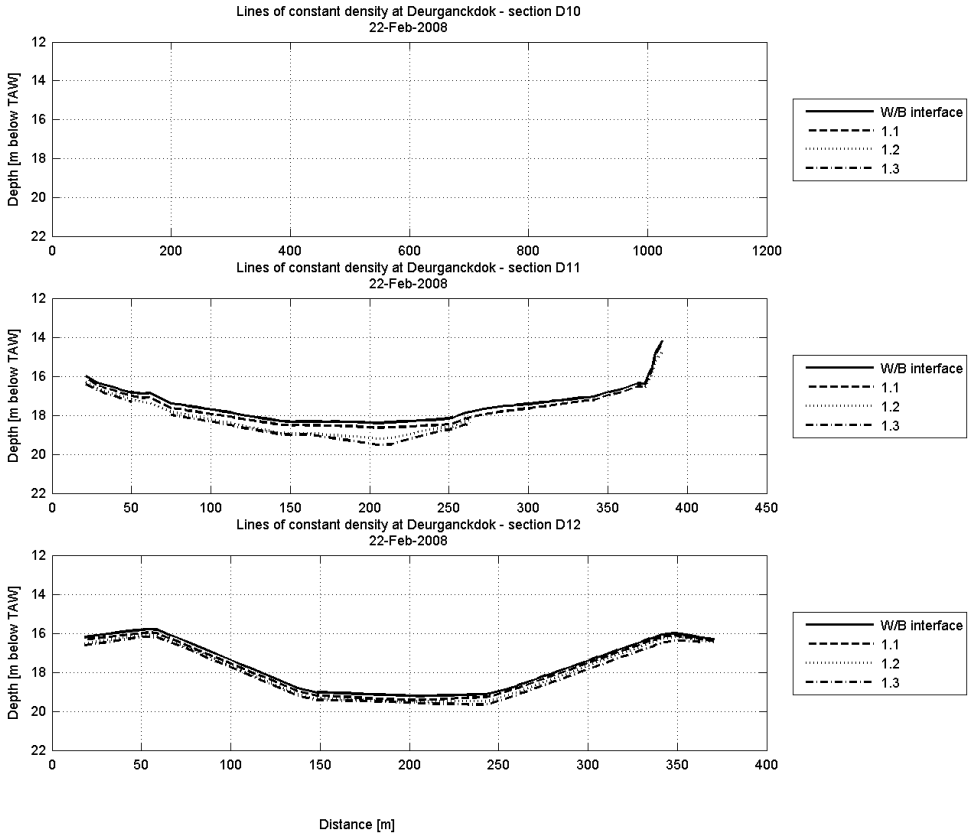
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



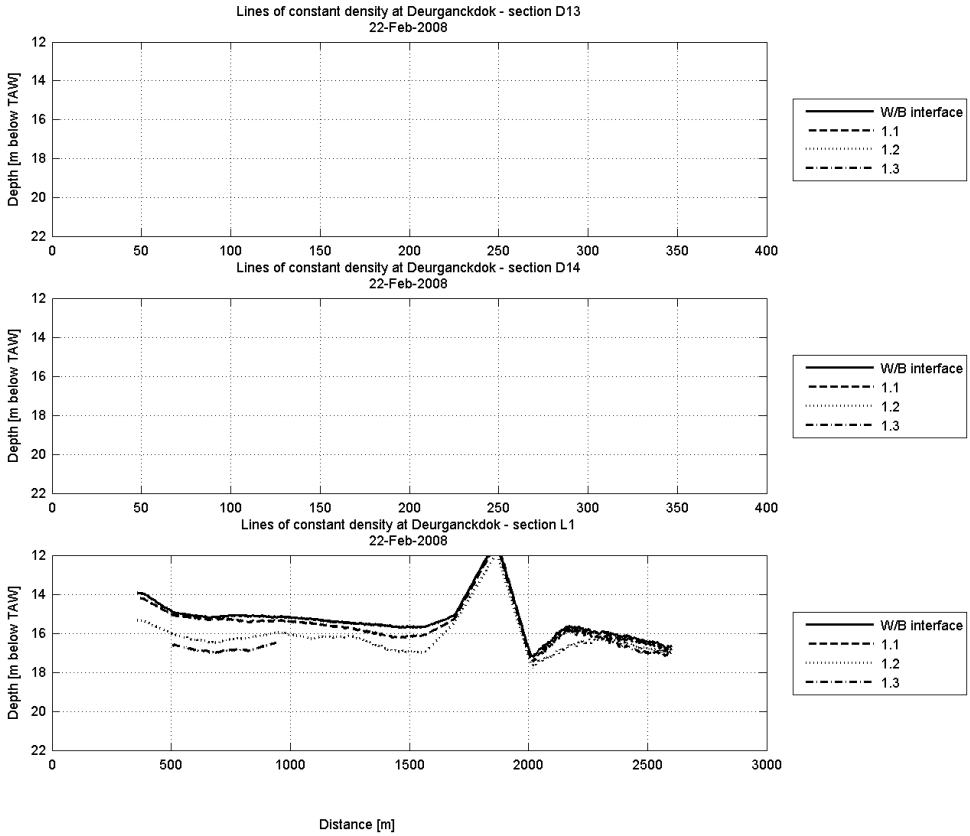
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



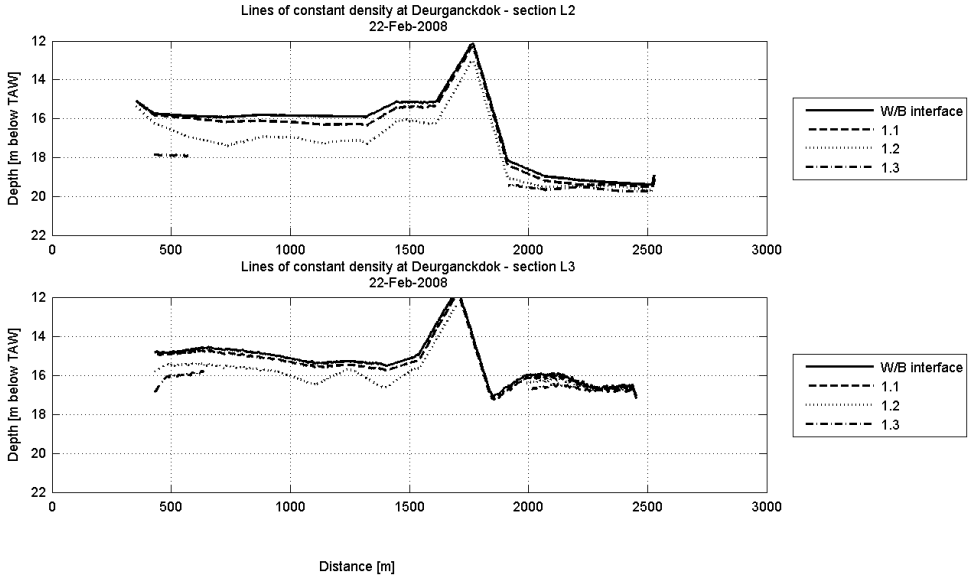
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Cross sections planes constant density	Equipment(s): NaviTracker
	Location: DGD



Data Processed by:

In association with :

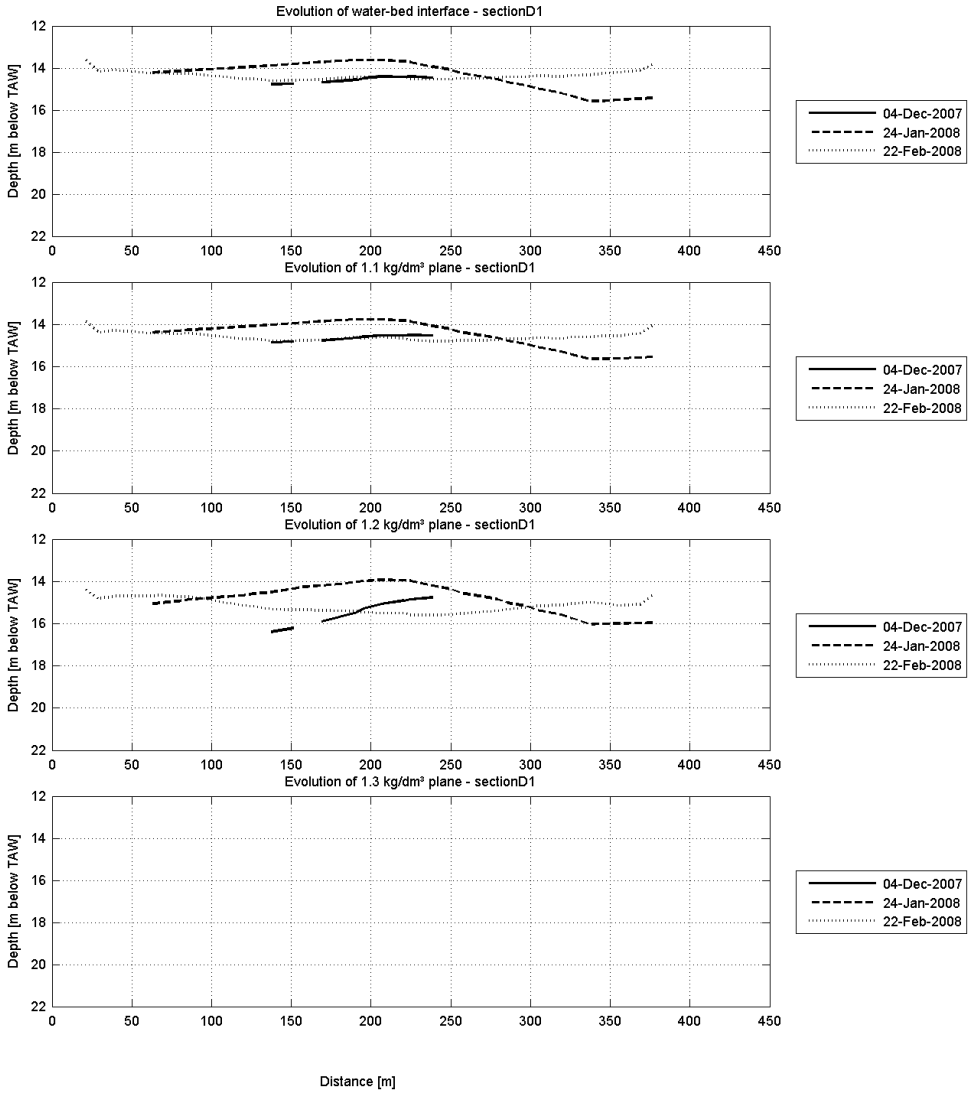
I/RA/11283/07.084/MSA

APPENDIX H.

DEPTH EVOLUTION OF PLANES OF CONSTANT DENSITY

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



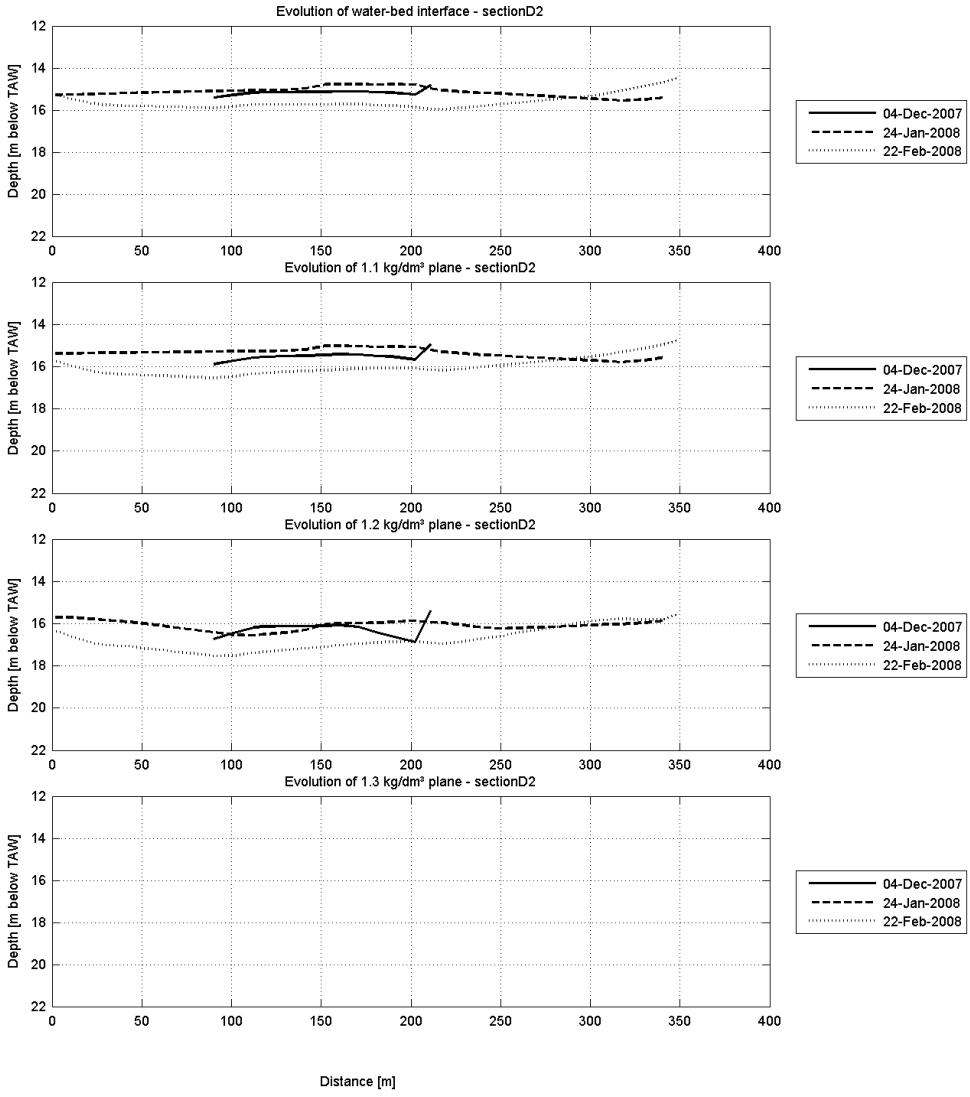
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



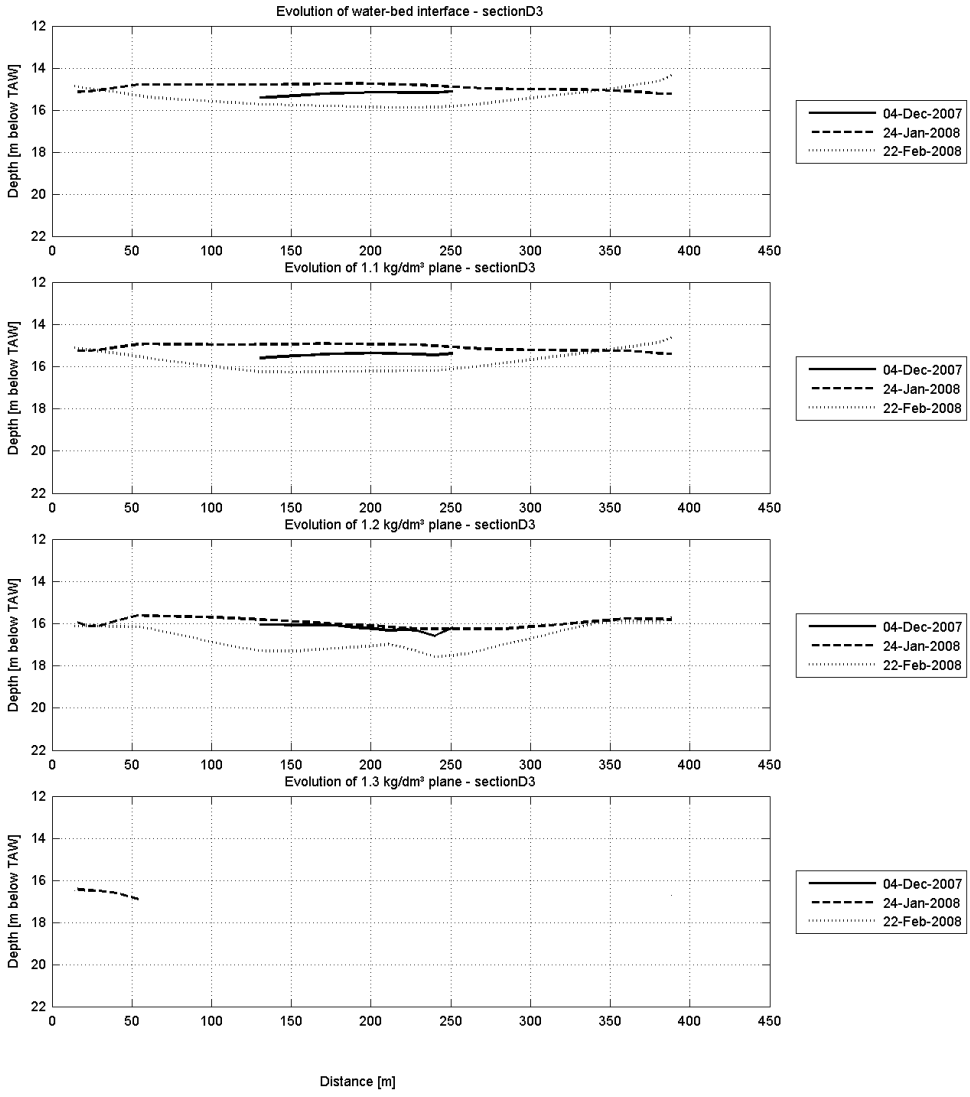
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



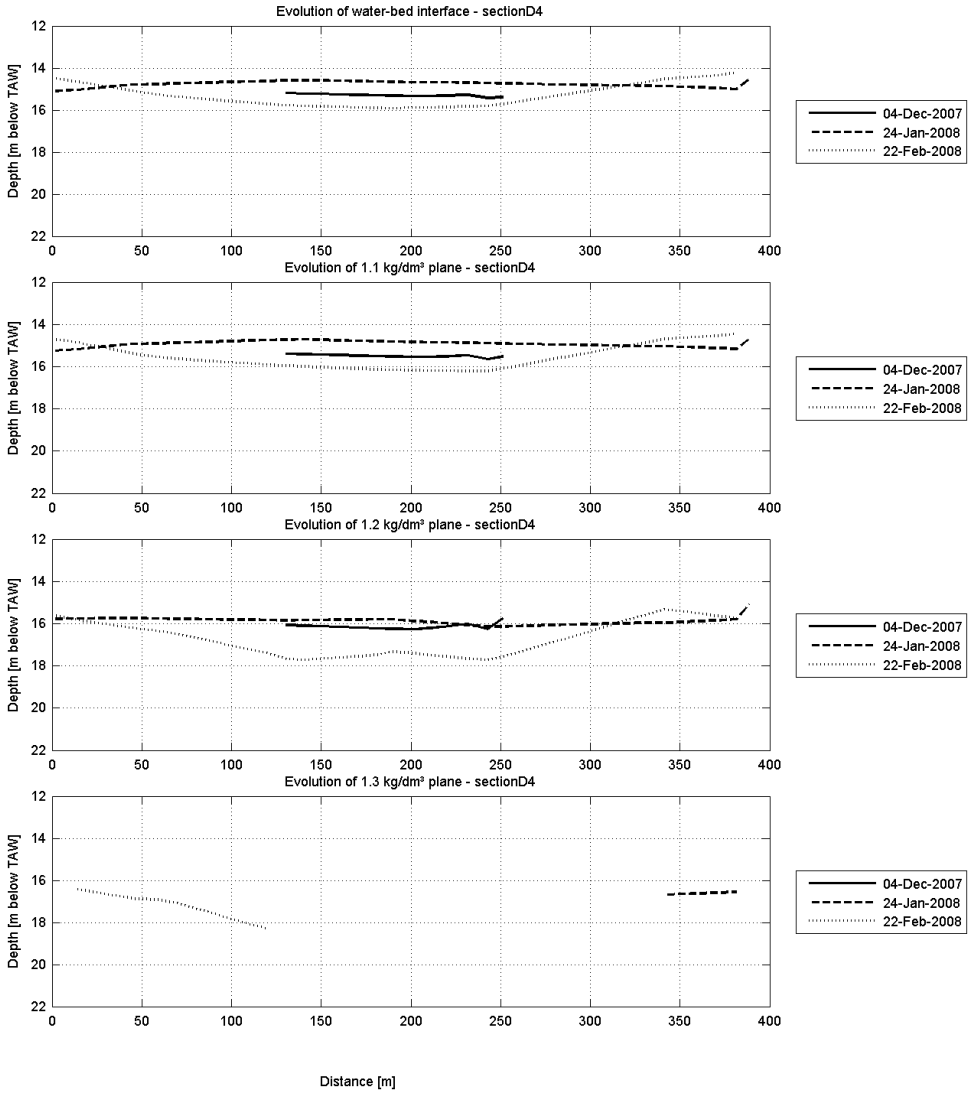
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



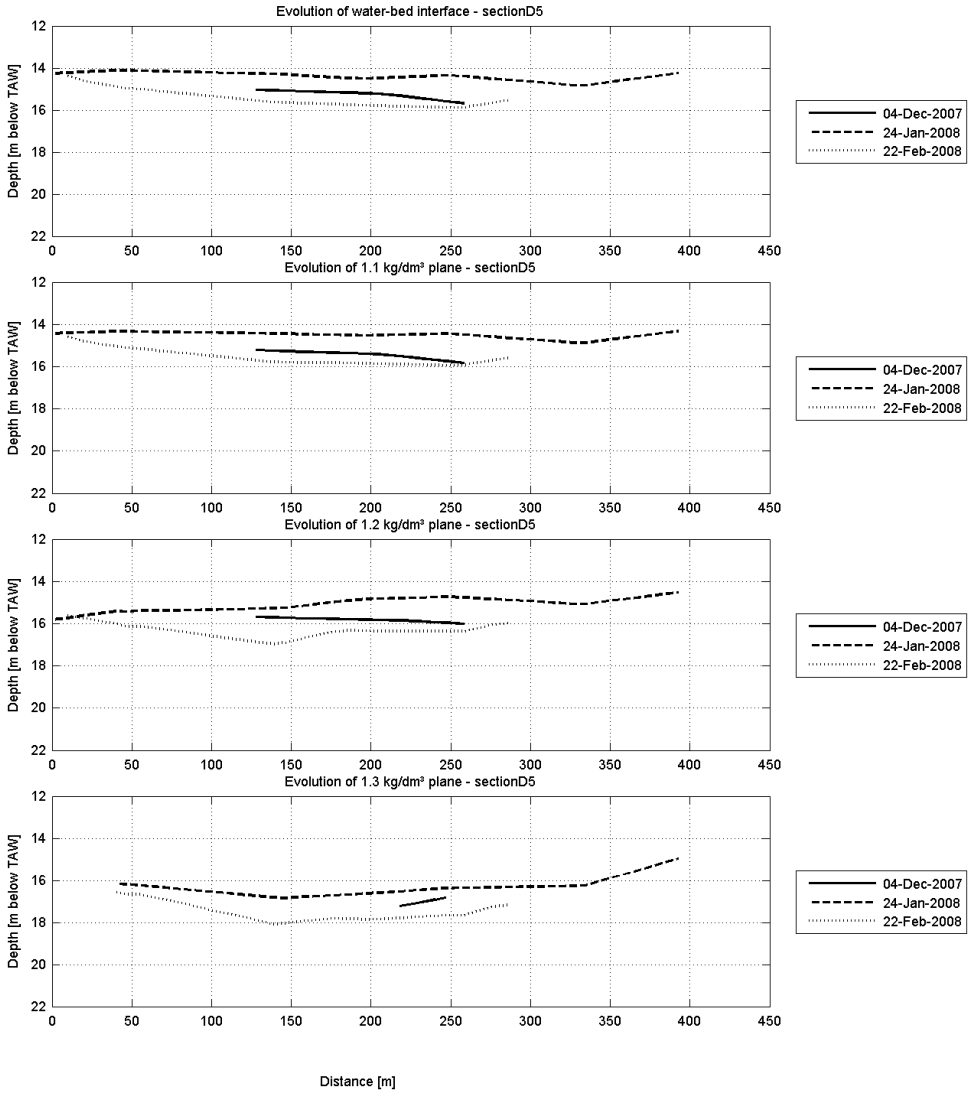
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



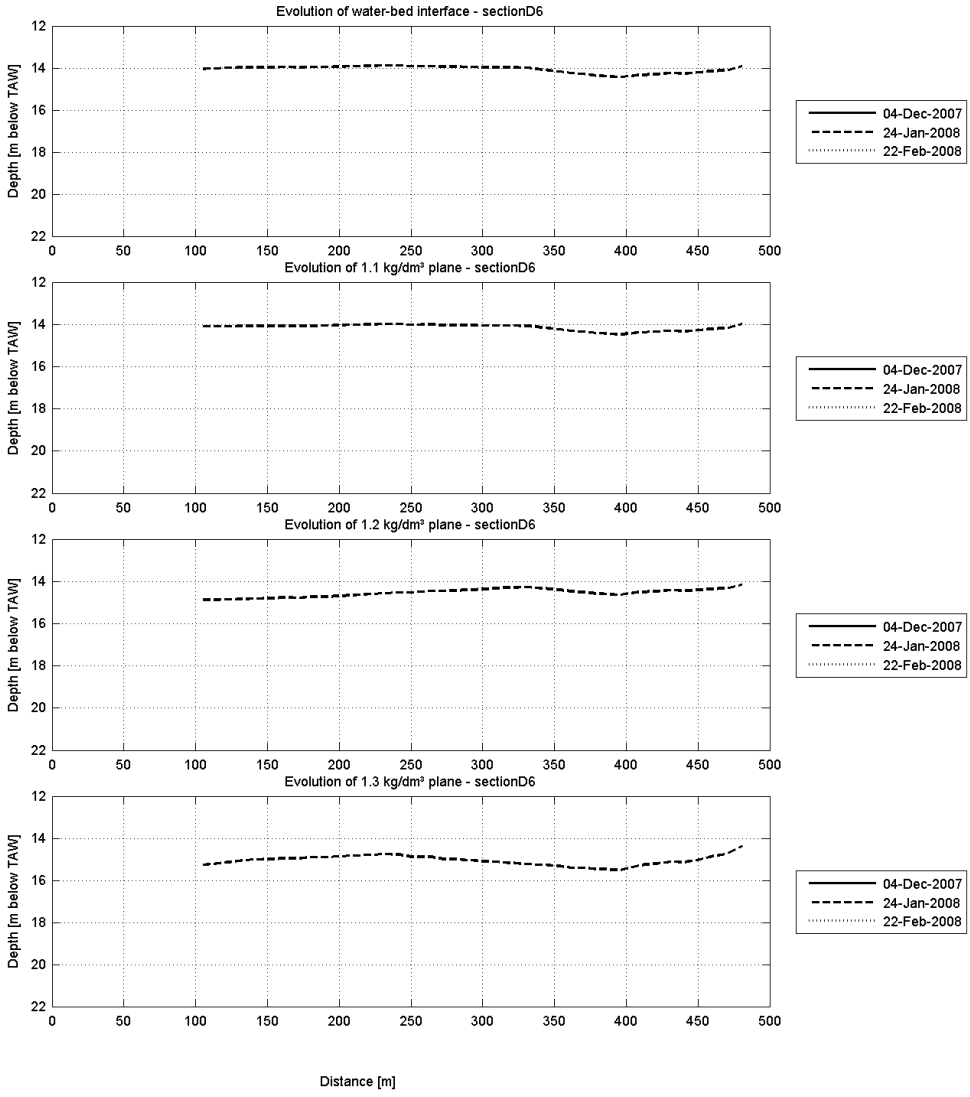
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



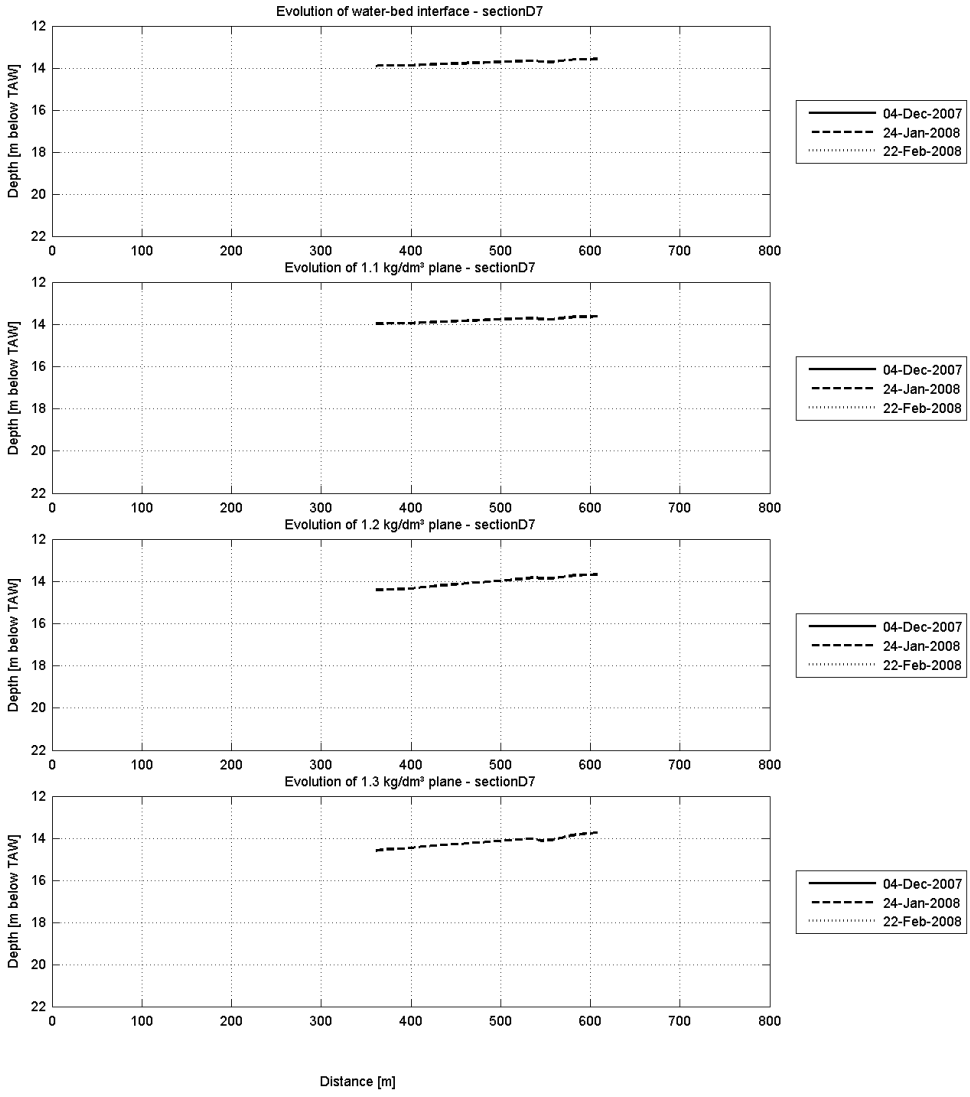
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



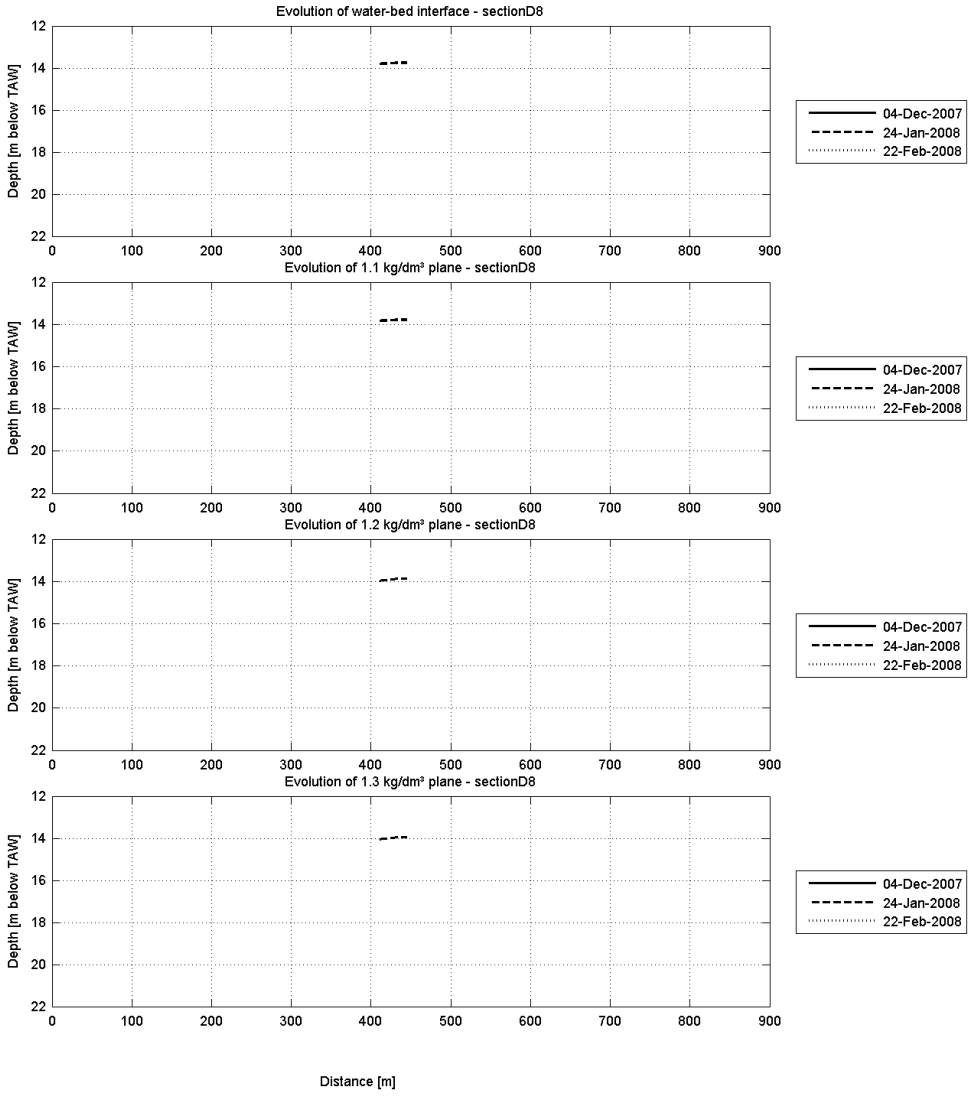
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



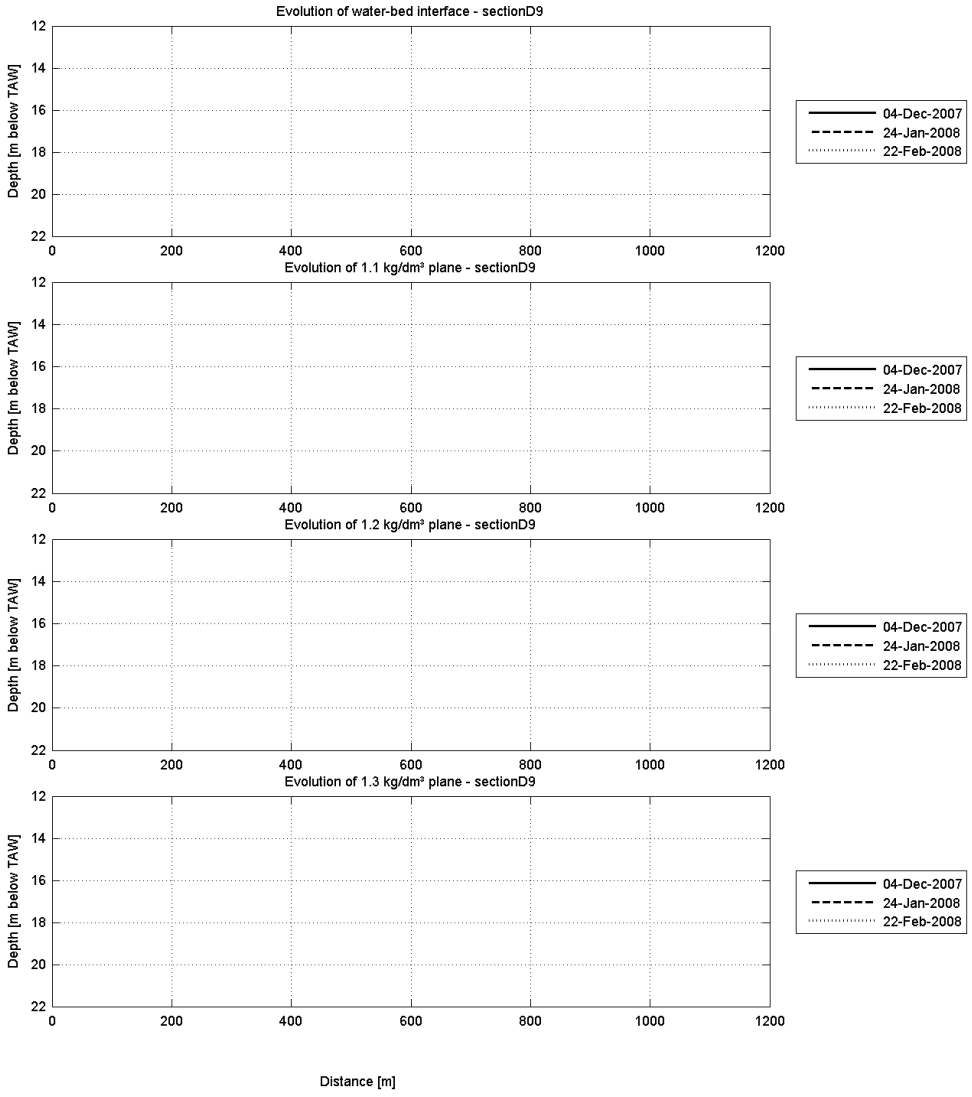
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



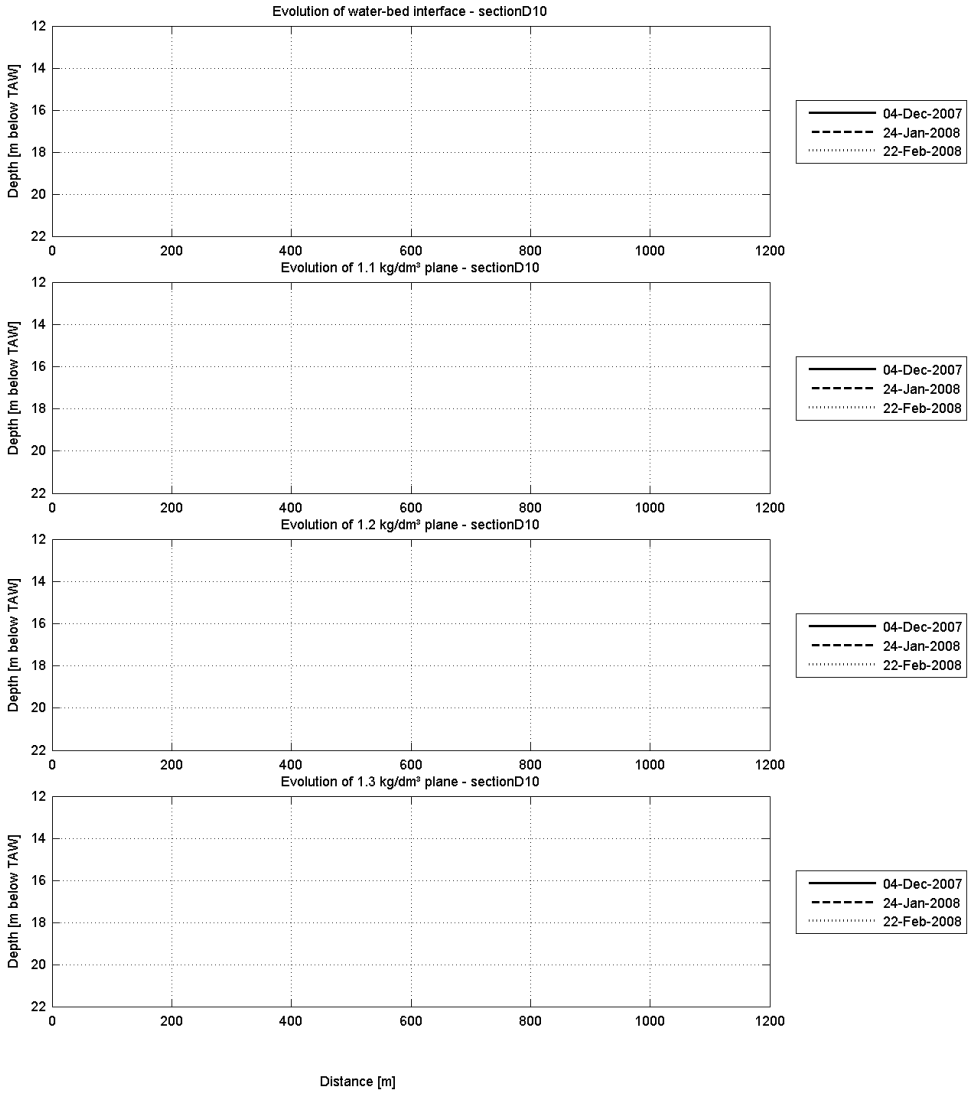
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



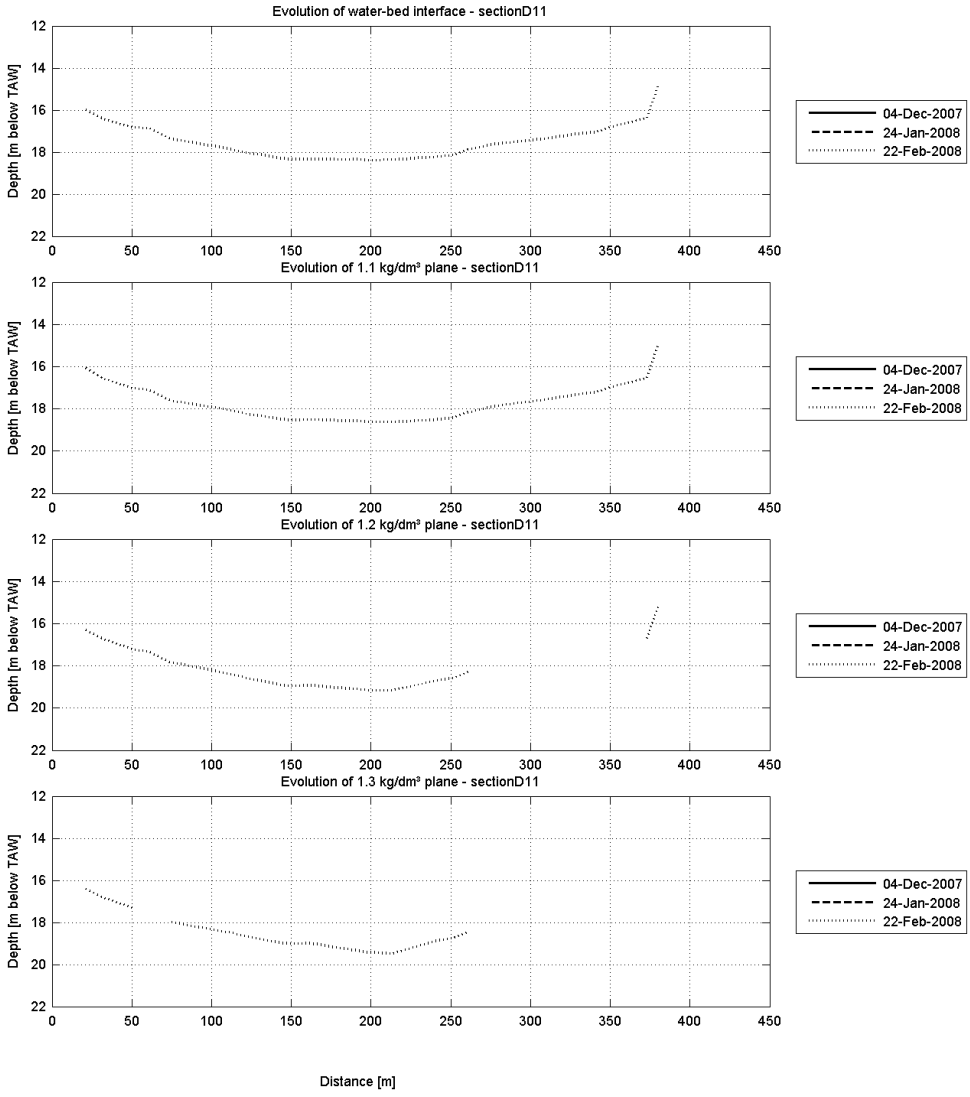
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



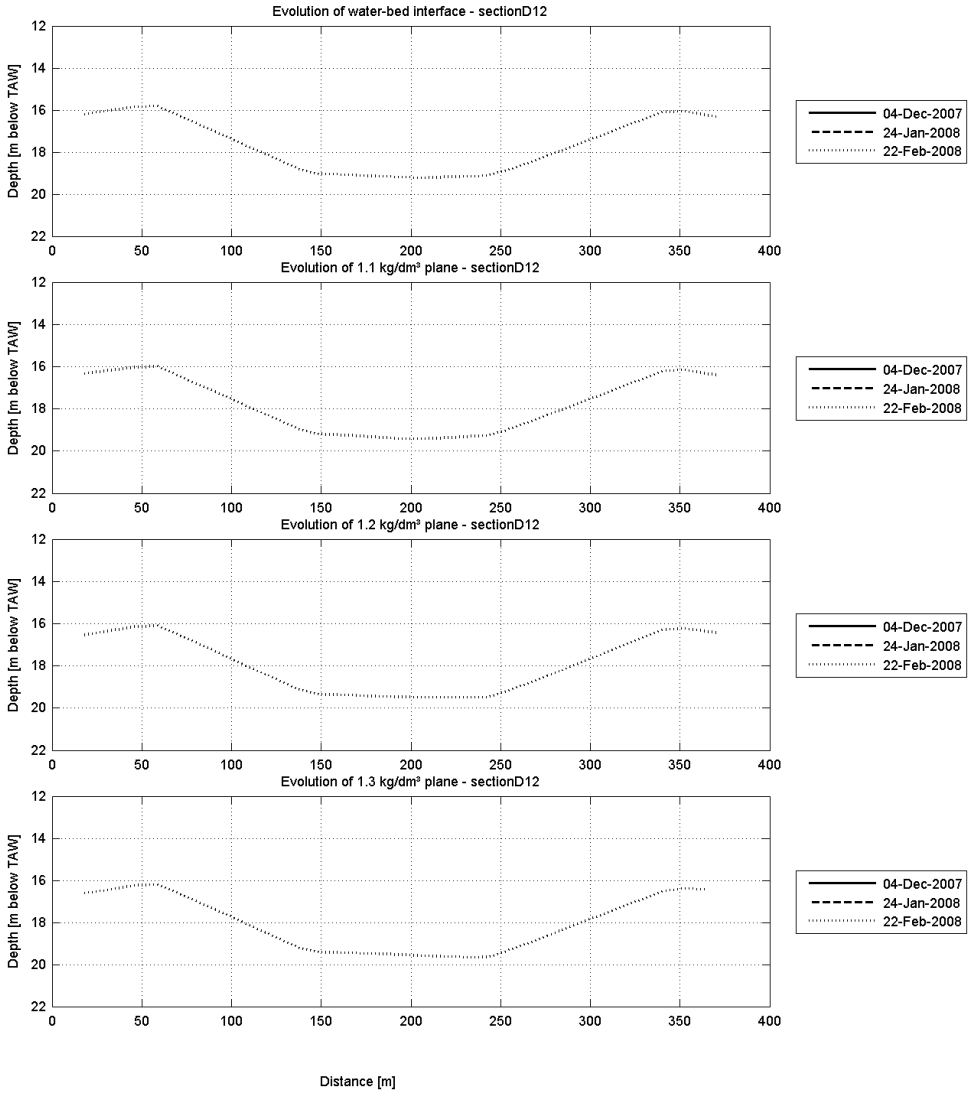
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



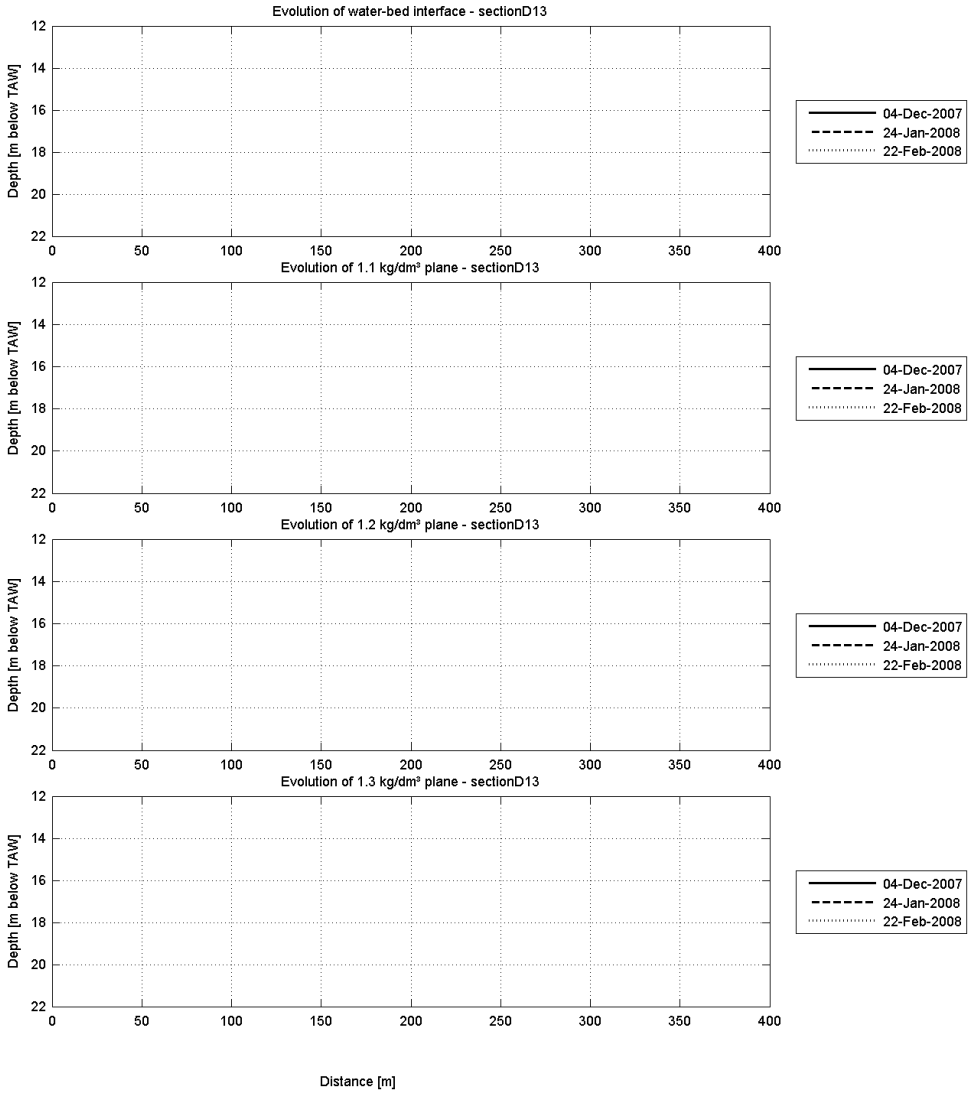
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



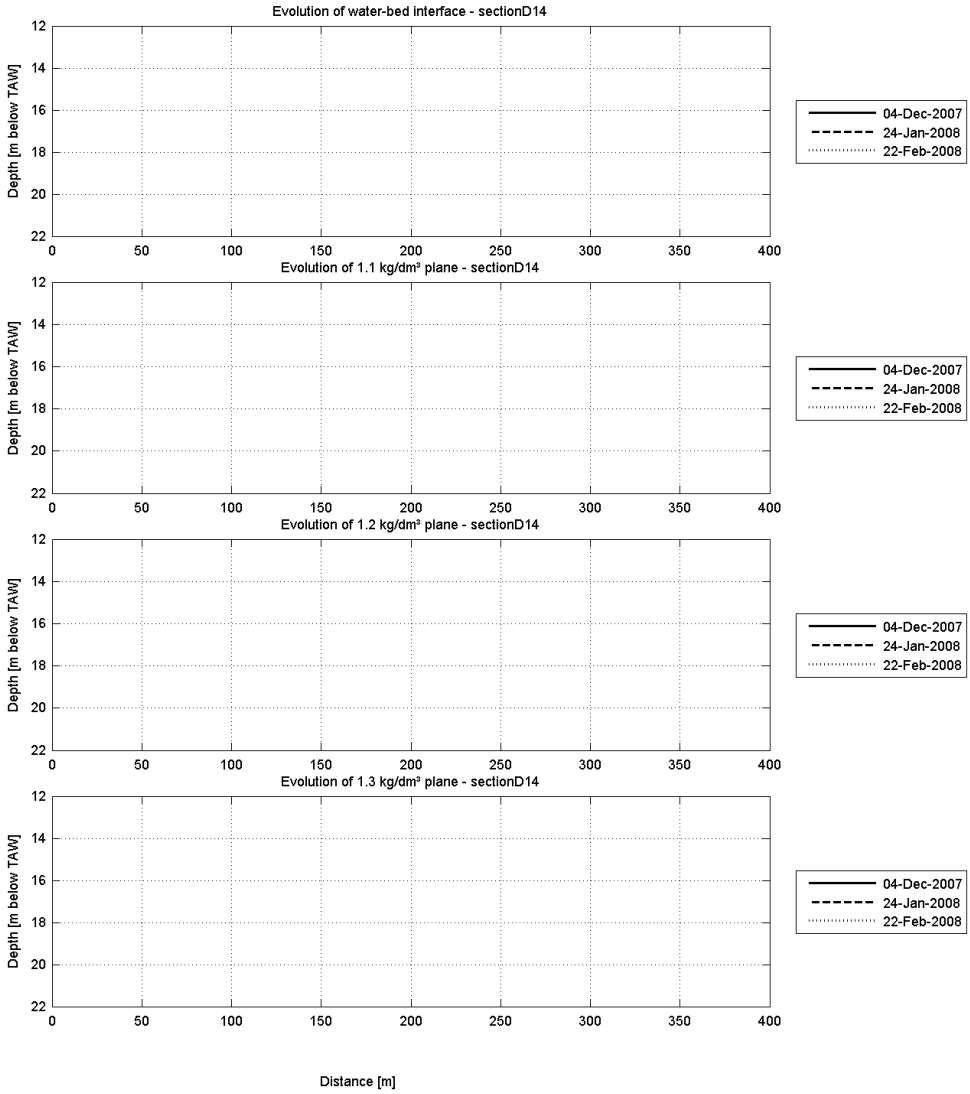
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



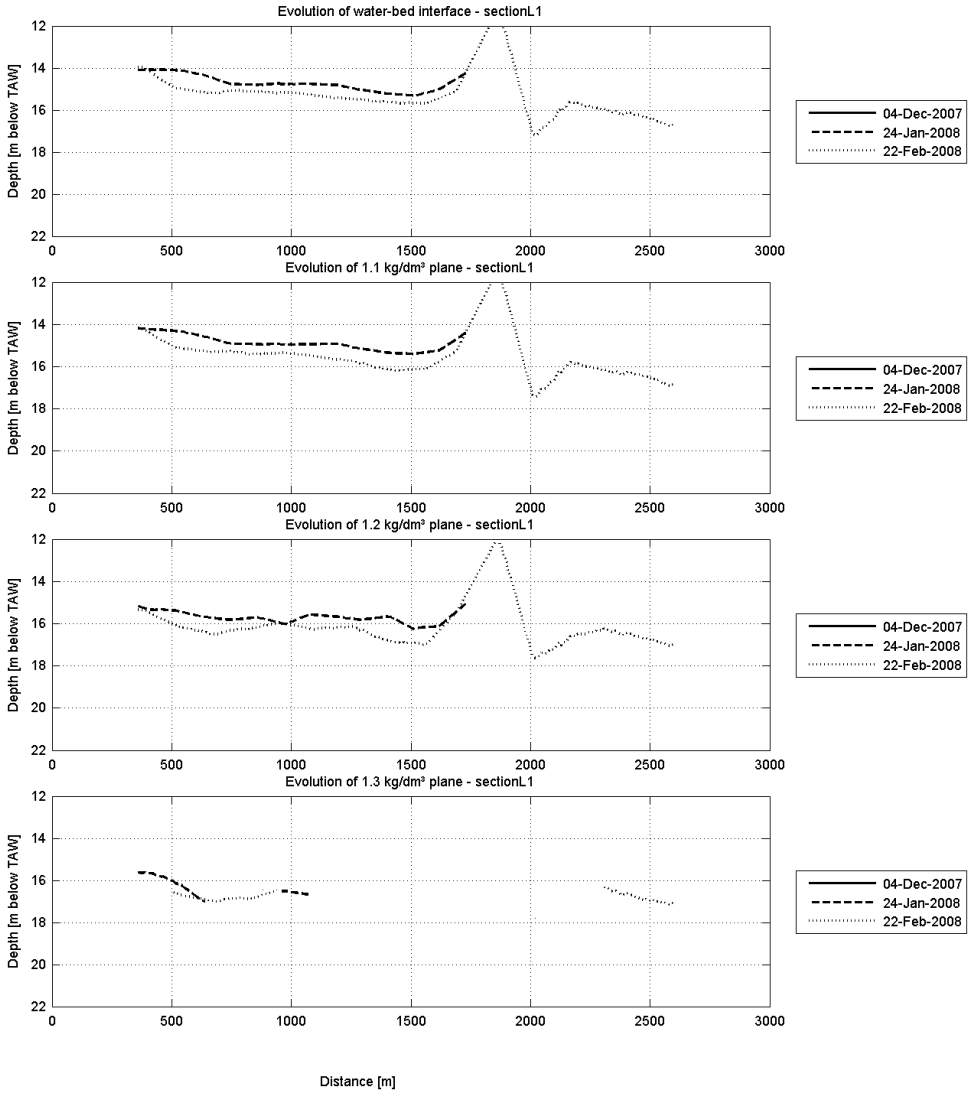
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



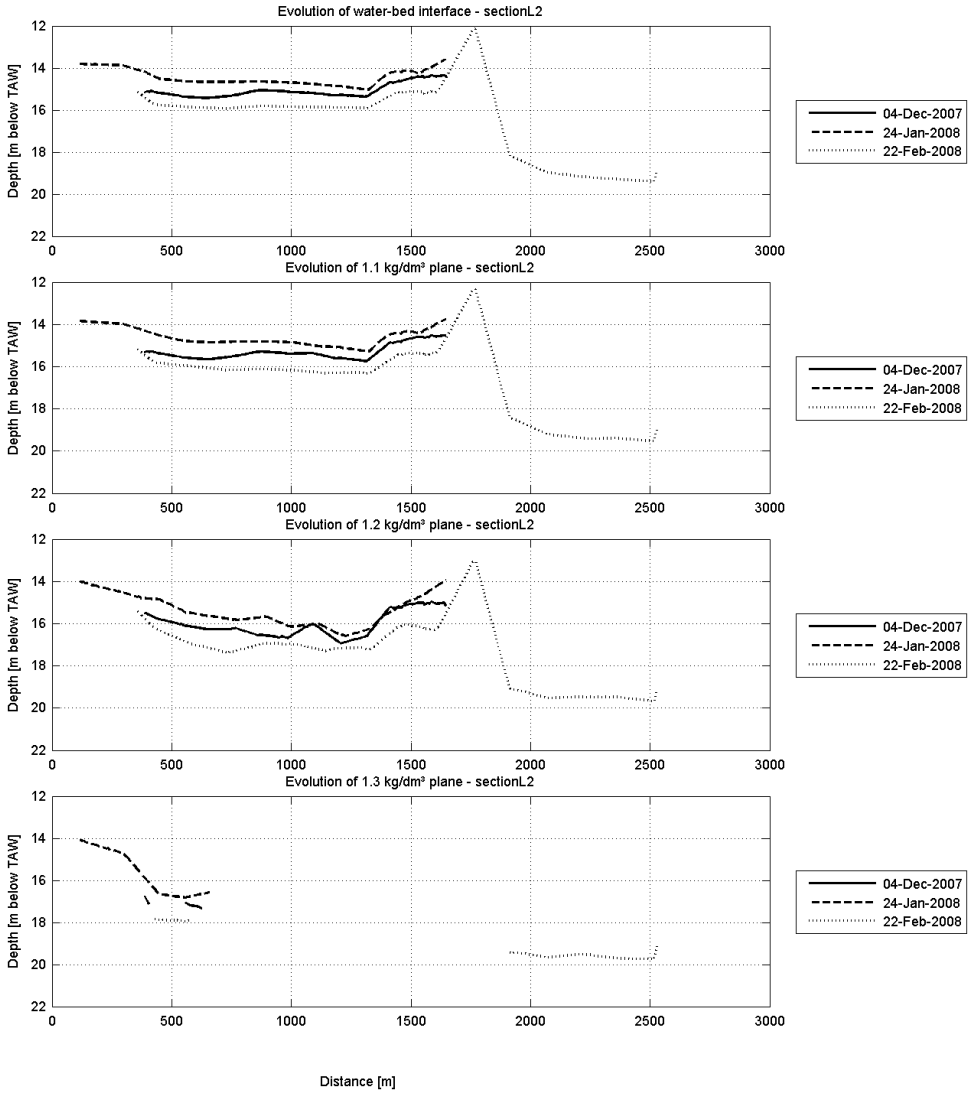
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



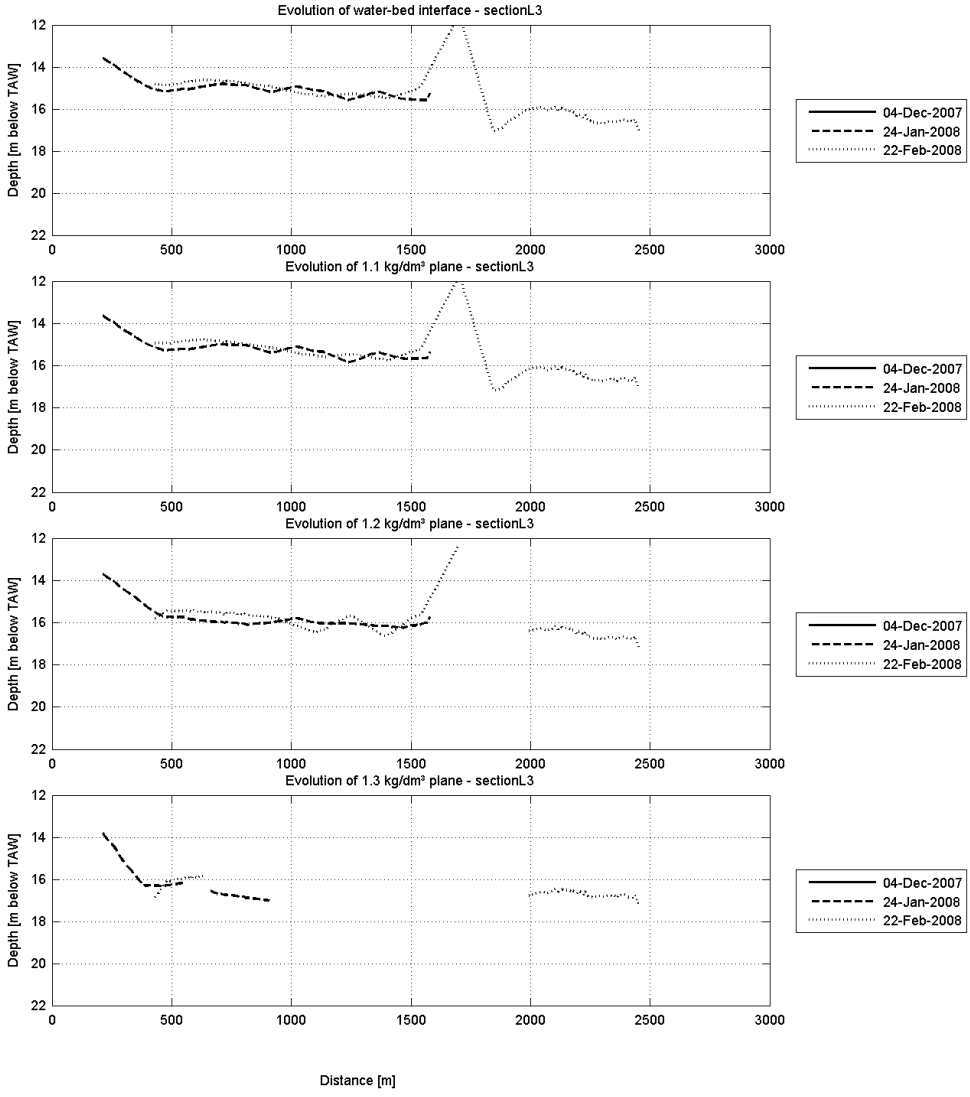
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Evolution of planes of constant density	Equipment(s): NaviTracker
	Location: DGD



Data Processed by:

In association with :

I/RA/11283/07.084/MSA

APPENDIX I.

SEDIMENT MASS DISTRIBUTION IN DEURGANCKDOK

APPENDIX J.

AVERAGE MASS GROWTH AND GROWTH RATE

J.1 Tabular results

****Measured Mass (TDS/m²)**

	04-Dec-07	24-Jan-08	22-Feb-08
1	-	-	-
2	-	-	-
3a	-	1.716	1.186
3b	1.286	1.325	0.912
3c	1.261	1.249	1.027
3d	-	-	0.917
3e	-	-	-
4Na	-	0.942	0.744
4Nb	-	0.82	0.577
4Nc	-	0.749	0.618
4Nd	-	-	0.874
4Ne	-	-	-
4Za	-	0.937	0.997
4Zb	-	0.751	0.681
4Zc	-	0.545	0.622
4Zd	-	-	0.815
4Ze	-	-	-
5Na	-	0.842	-
5Nb	-	0.697	-
5Nc	-	-	-
5Nd	-	-	-
5Ne	-	-	-
5Za	-	0.683	-
5Zb	-	0.693	-
5Zc	-	-	-
5Zd	-	-	-
5Ze	-	-	-

Area mean	1.332	1.12	0.843

****Cumulative dredged mass in covered area (TDS)**

	04-Dec-07	24-Jan-08	22-Feb-08
1	0	0	0
2	0	0	311
3a	0	0	85174
3b	0	0	72879
3c	0	0	59901
3d	0	0	454
3e	0	0	0
4Na	0	0	12218
4Nb	0	0	10737
4Nc	0	0	7174
4Nd	0	0	0
4Ne	0	0	0
4Za	0	0	7078
4Zb	0	0	7945
4Zc	0	0	3590
4Zd	0	0	0
4Ze	0	0	0
5Na	0	0	0
5Nb	0	0	63
5Nc	0	0	6
5Nd	0	0	0
5Ne	0	0	0
5Za	0	0	0
5Zb	0	0	0
5Zc	0	0	0
5Zd	0	0	0
5Ze	0	0	0

Total	0	0	267530

****Total cumulative mass(TDS/m²)**

	04-Dec-07	24-Jan-08	22-Feb-08
1	-	-	-
2	-	-	-
3a	-	1.716	2.141
3b	1.286	1.325	1.575
3c	1.261	1.249	1.632
3d	-	-	0.921
3e	-	-	-
4Na	-	0.942	1.126
4Nb	-	0.82	0.922
4Nc	-	0.749	0.897
4Nd	-	-	0.874
4Ne	-	-	-
4Za	-	0.937	1.356
4Zb	-	0.751	0.936
4Zc	-	0.545	0.761
4Zd	-	-	0.815
4Ze	-	-	-
5Na	-	0.842	-
5Nb	-	0.697	-
5Nc	-	-	-
5Nd	-	-	-
5Ne	-	-	-
5Za	-	0.683	-
5Zb	-	0.693	-
5Zc	-	-	-
5Zd	-	-	-
5Ze	-	-	-

Mean	1.332	1.12	1.172

****Growth rate (kg/m²/day)**

	04-Dec-2007 / 24-Jan-2008	24-Jan-2008 / 22-Feb-2008
1	-	-
2	-	-
3a	-	14.67
3b	0.75	8.64
3c	-0.24	13.21
3d	-	-
3e	-	-
4Na	-	6.37
4Nb	-	3.50
4Nc	-	5.13
4Nd	-	-
4Ne	-	-
4Za	-	14.42
4Zb	-	6.38
4Zc	-	7.42
4Zd	-	-
4Ze	-	-
5Na	-	-
5Nb	-	-
5Nc	-	-
5Nd	-	-
5Ne	-	-
5Za	-	-
5Zb	-	-
5Zc	-	-
5Zd	-	-
5Ze	-	-

Mean	-4.15	1.79

****Covered Area (ha)**

	04-Dec-07	24-Jan-08	22-Feb-08
1	0	0.05	0
2	0	4.17	0
3a	4.83	9.87	8.68
3b	6.42	10.99	10.99
3c	5.02	8.93	9.91
3d	0	0	13.06
3e	0	0	5.04
4Na	0	3.3	3.19
4Nb	0	3.12	3.12
4Nc	0	2.29	2.57
4Nd	0	0	3.28
4Ne	0	0	1.27
4Za	0	2.42	1.6
4Zb	0	3.12	3.12
4Zc	0	2.36	2.59
4Zd	0	0	3.23
4Ze	0	0	1.21
5Na	0	1.32	0.67
5Nb	0	1.19	0.82
5Nc	0	0.7	0.83
5Nd	0	0	1.02
5Ne	0	0	0.3
5Za	0	0.9	0.33
5Zb	0	1.13	0.96
5Zc	0	0.71	0.88
5Zd	0	0	1.14
5Ze	0	0	0.39

Total	16.27	56.56	80.17

****Percent of zone covered**

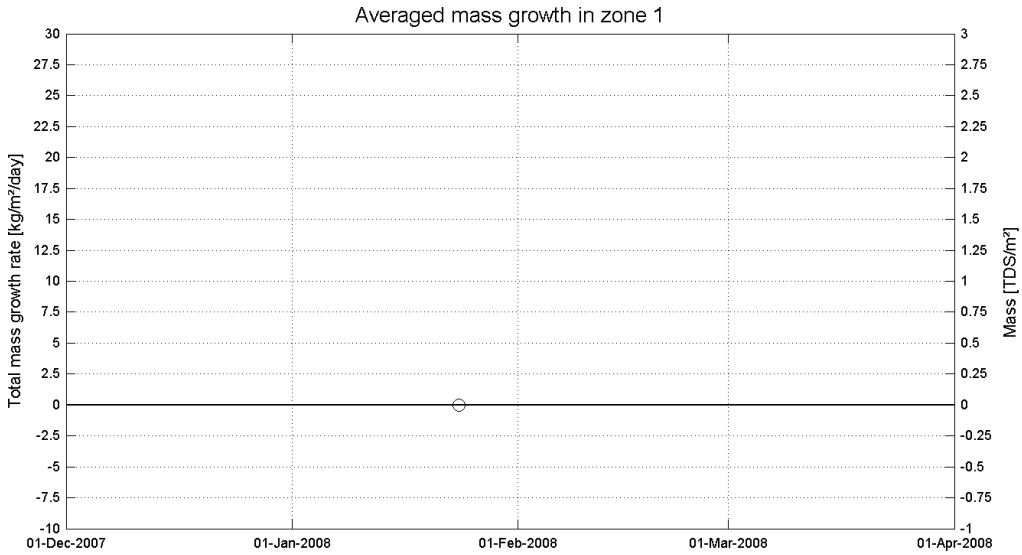
	04-Dec-07	24-Jan-08	22-Feb-08
1	0	0	0
2	0	34	0
3a	49	100	88
3b	58	100	100
3c	51	90	100
3d	0	0	100
3e	0	0	39
4Na	0	91	88
4Nb	0	100	100
4Nc	0	89	100
4Nd	0	0	100
4Ne	0	0	38
4Za	0	100	66
4Zb	0	100	100
4Zc	0	91	100
4Zd	0	0	100
4Ze	0	0	39
5Na	0	57	29
5Nb	0	60	41
5Nc	0	38	46
5Nd	0	0	43
5Ne	0	0	13
5Za	0	69	25
5Zb	0	57	48
5Zc	0	40	49
5Zd	0	0	48
5Ze	0	0	16

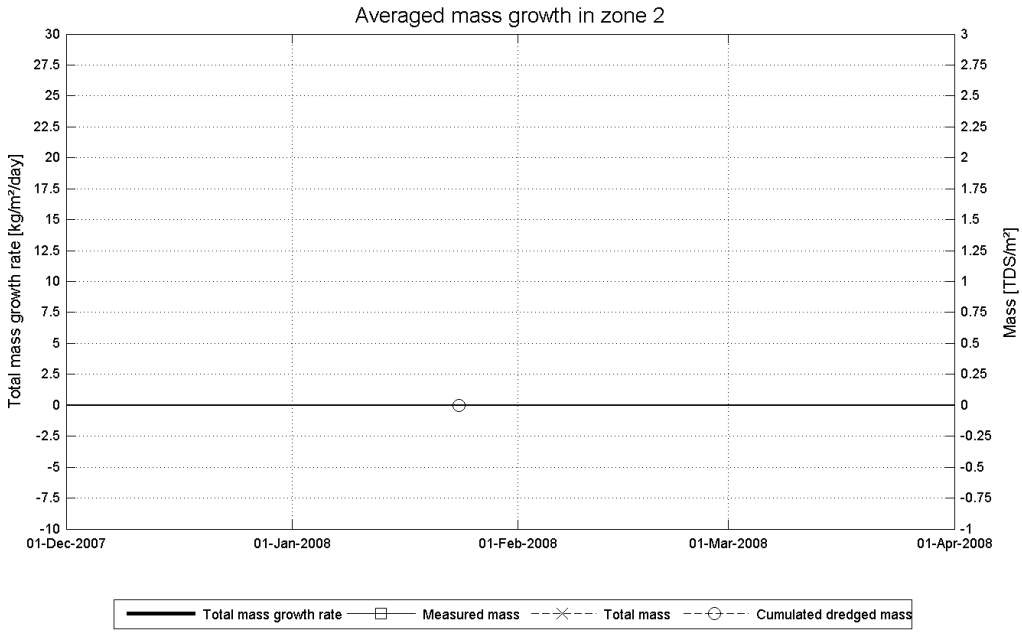
Mean	6	45	60

J.2 For each zone

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD





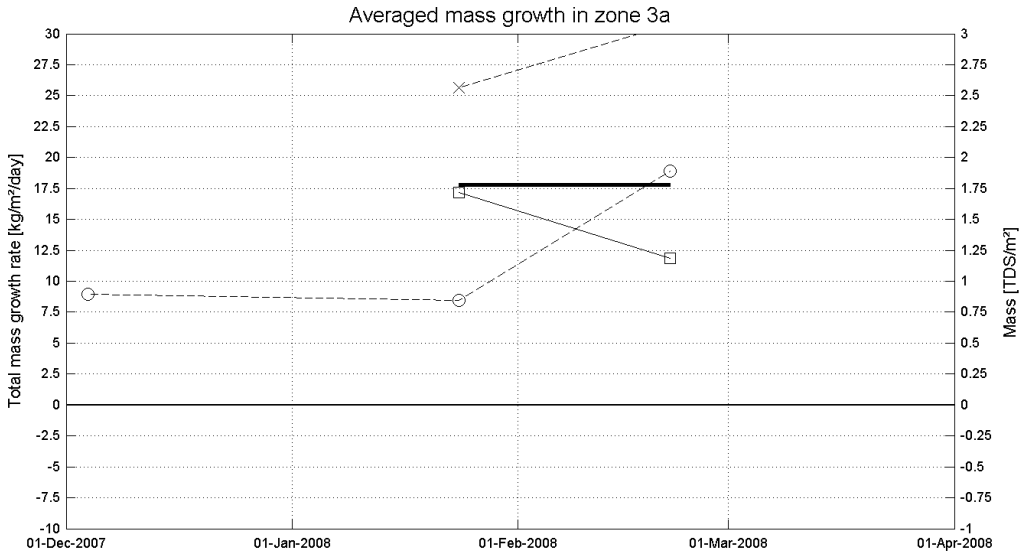
Data Processed by:

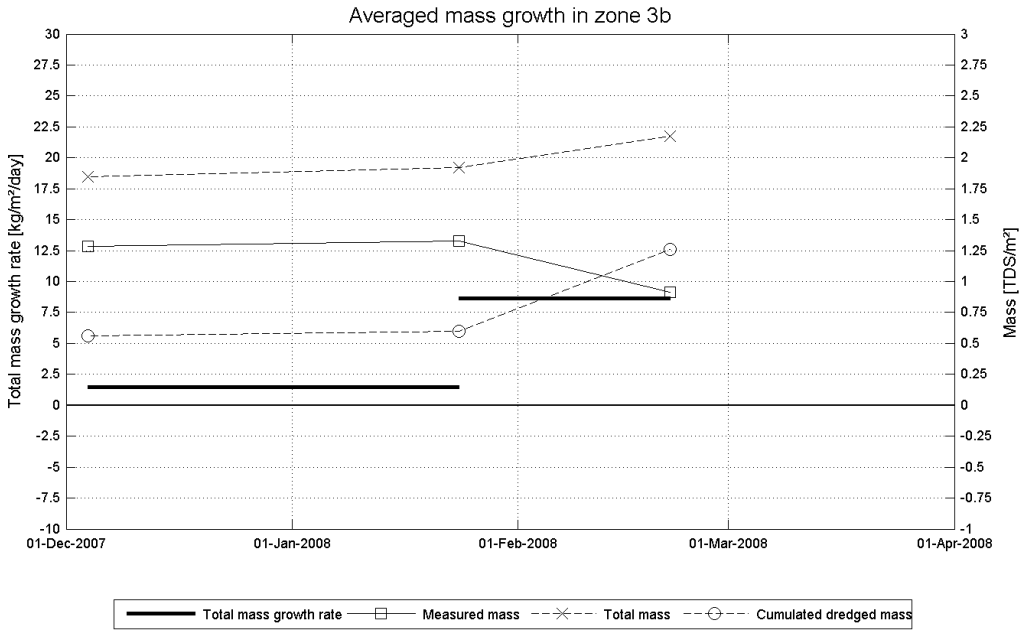
In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD





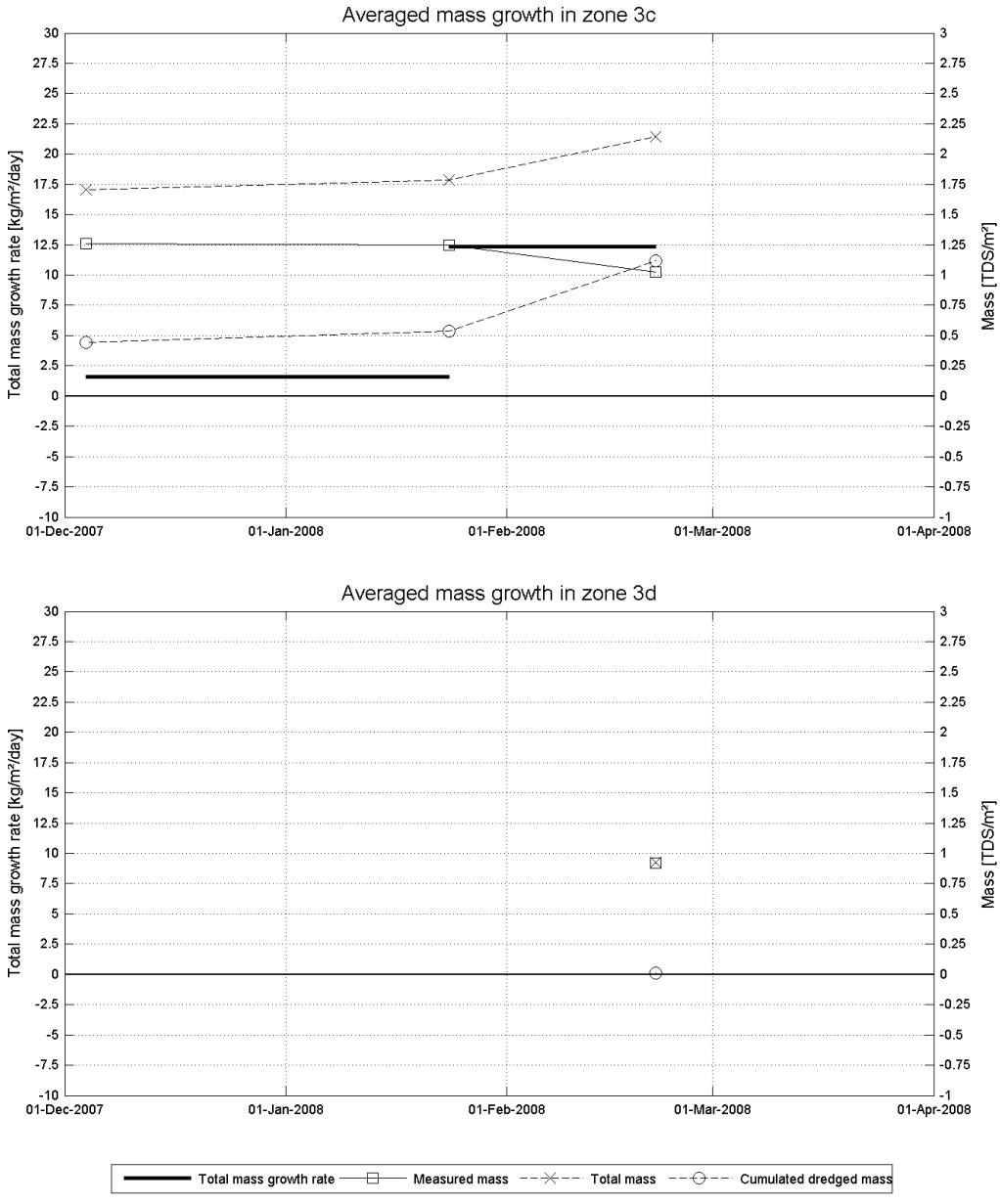
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD



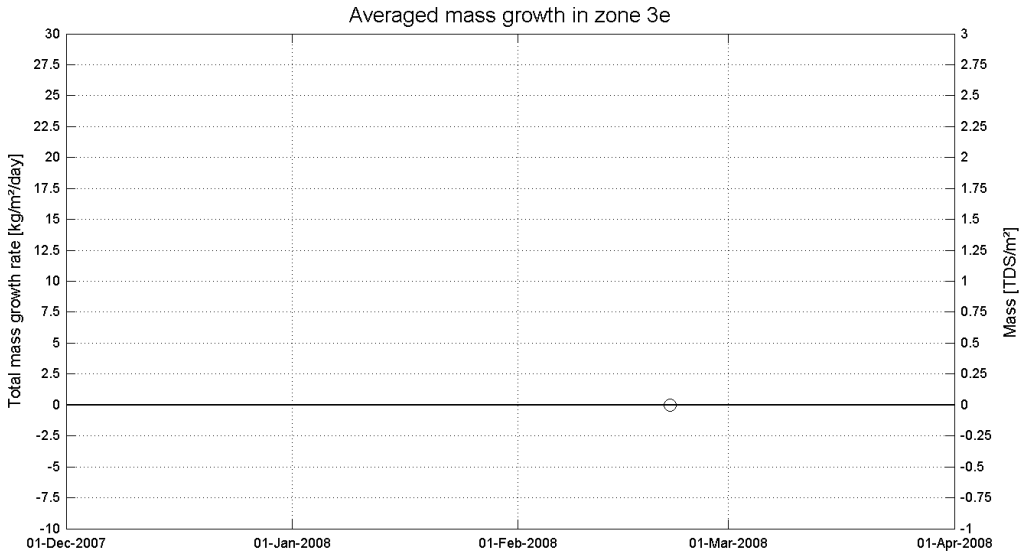
Data Processed by:

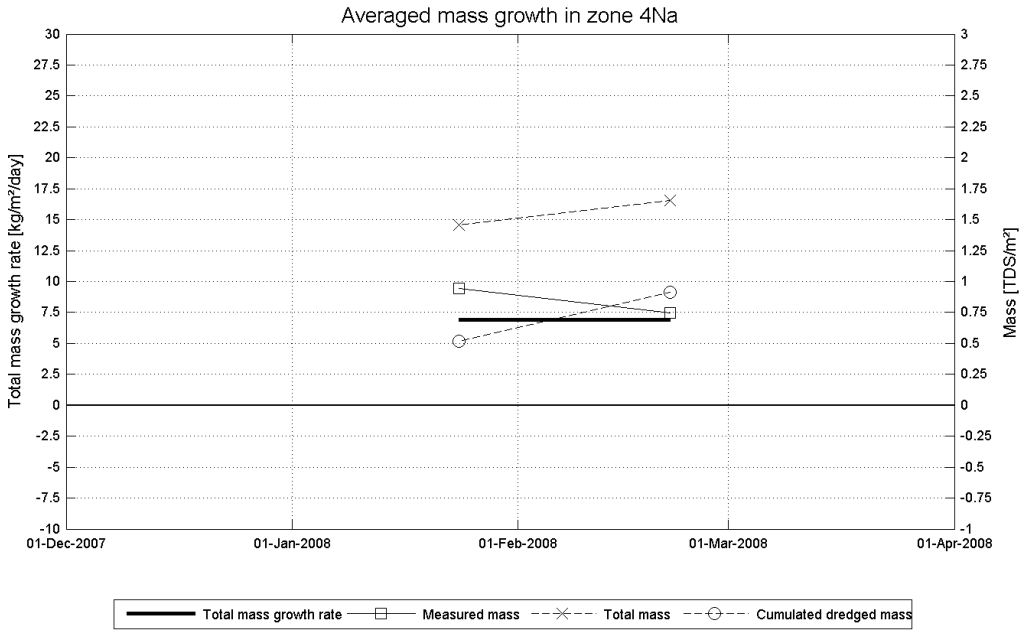
In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD





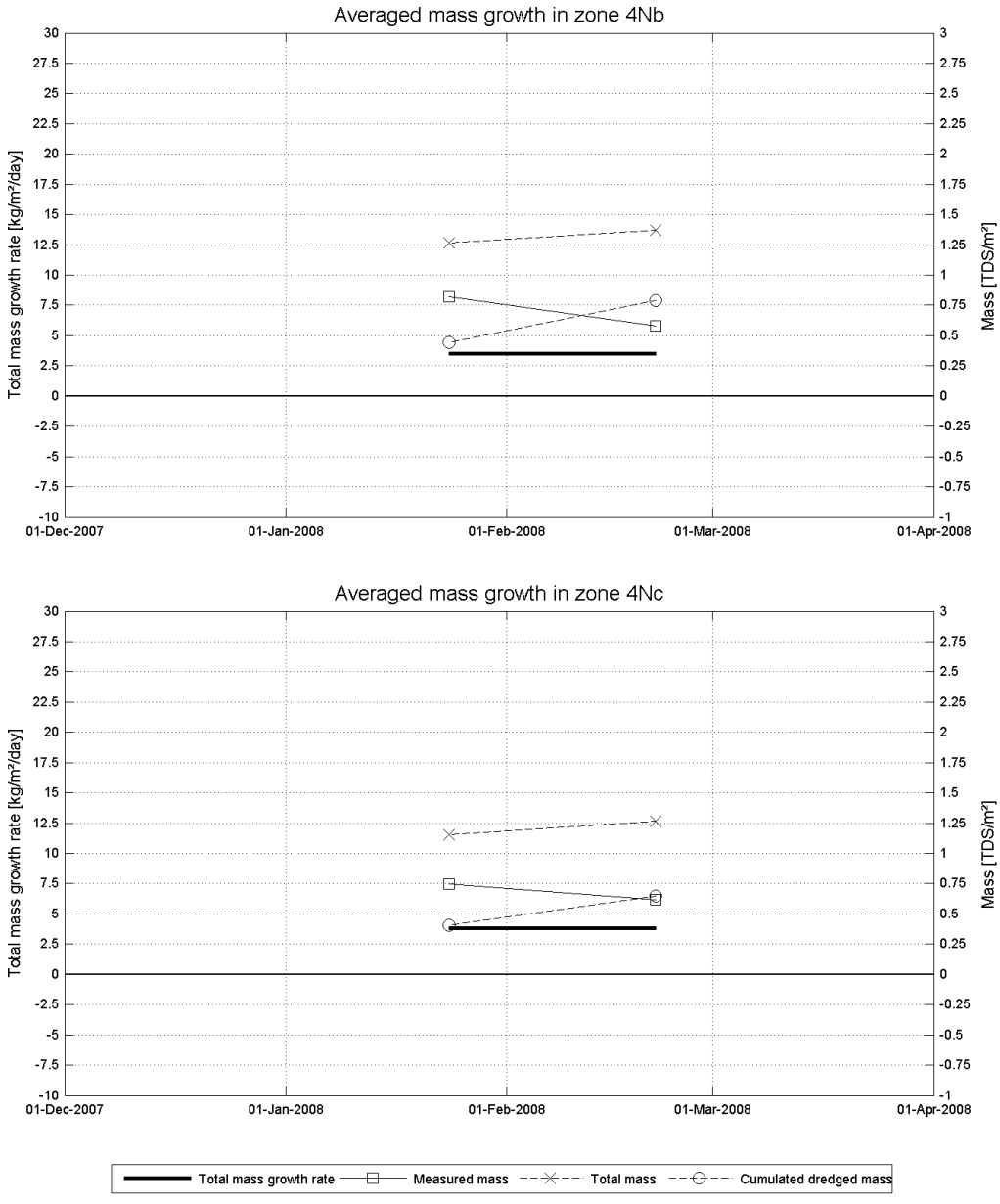
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD



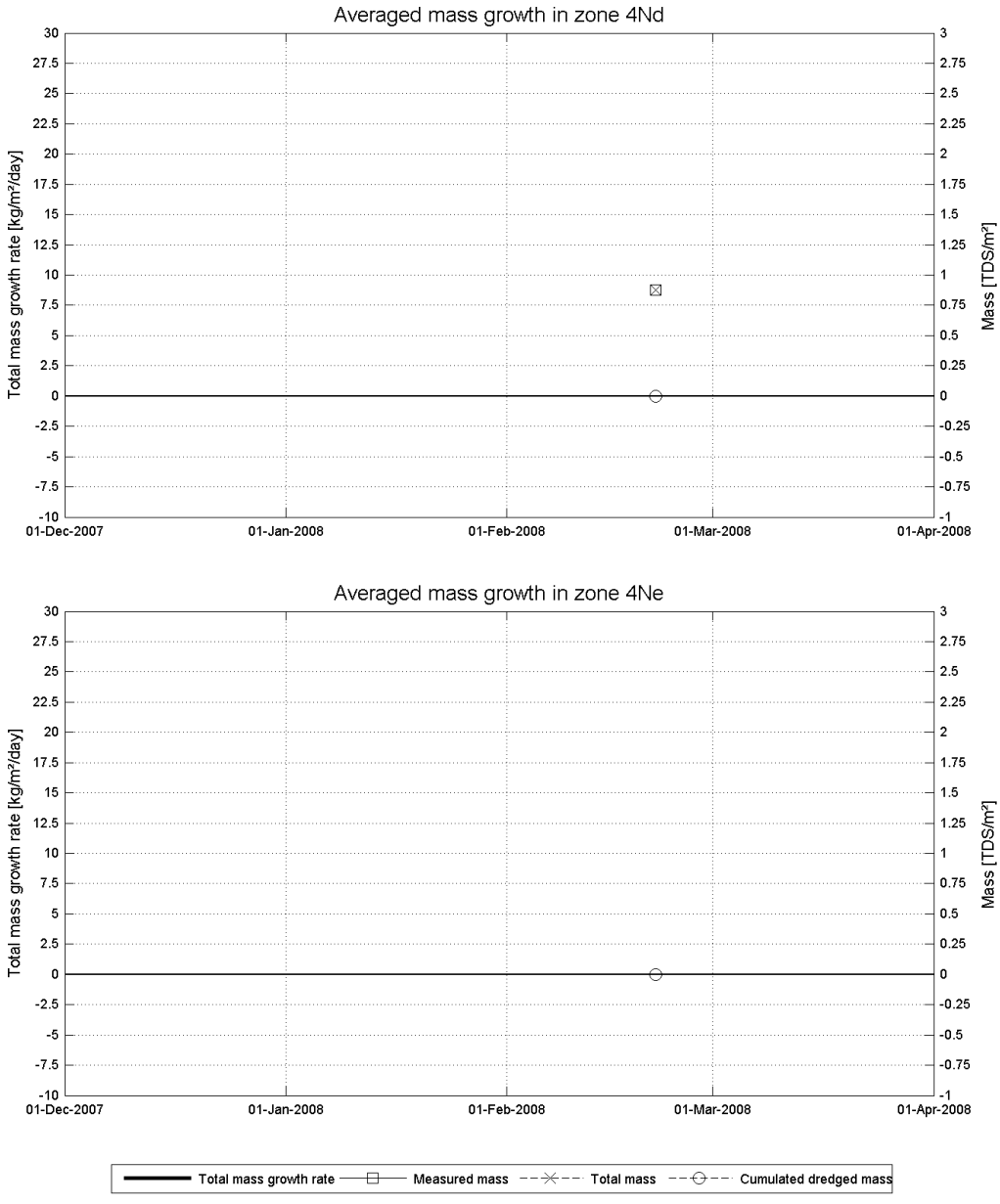
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD



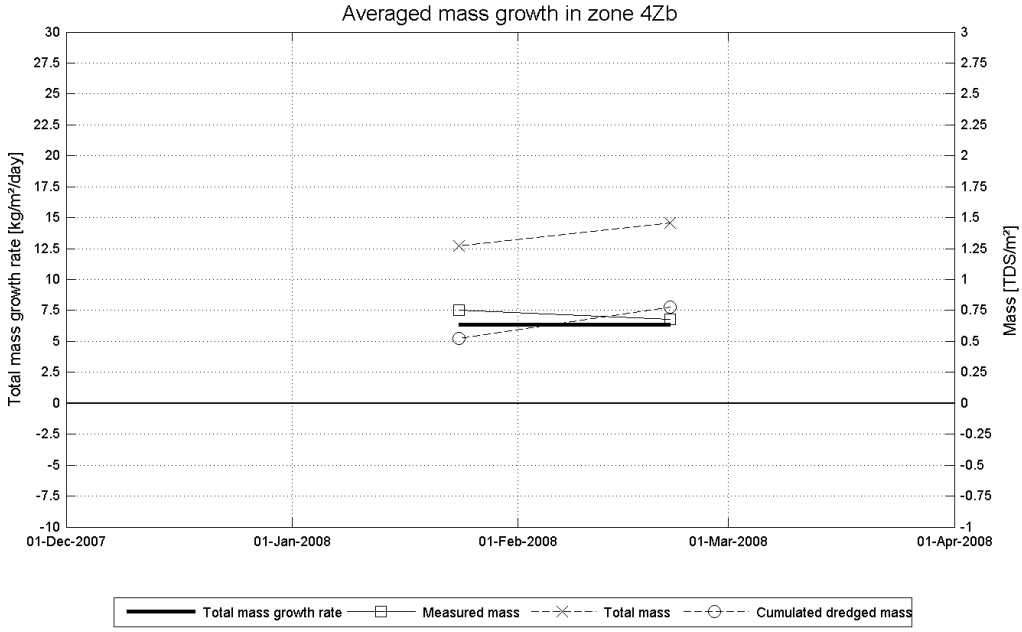
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD



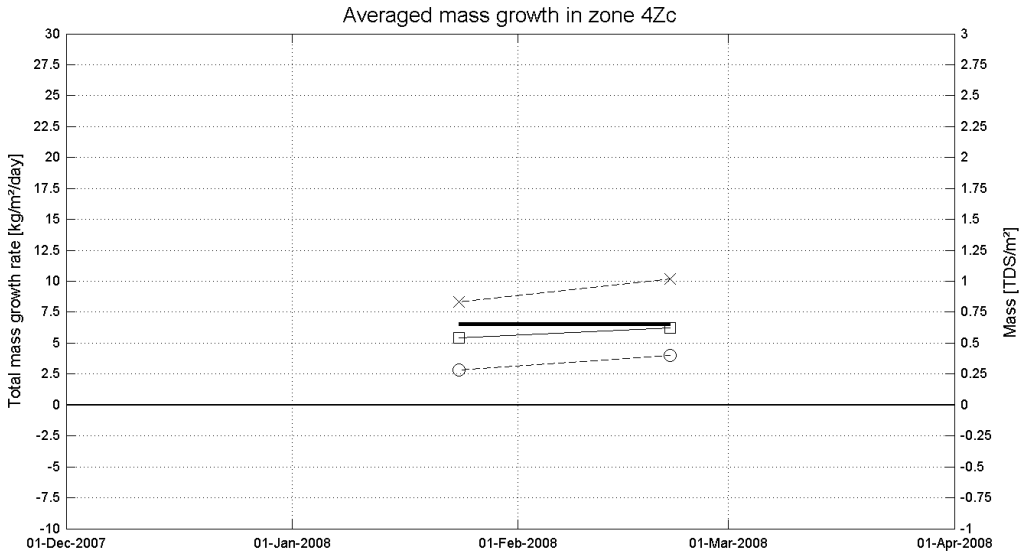
Data Processed by:

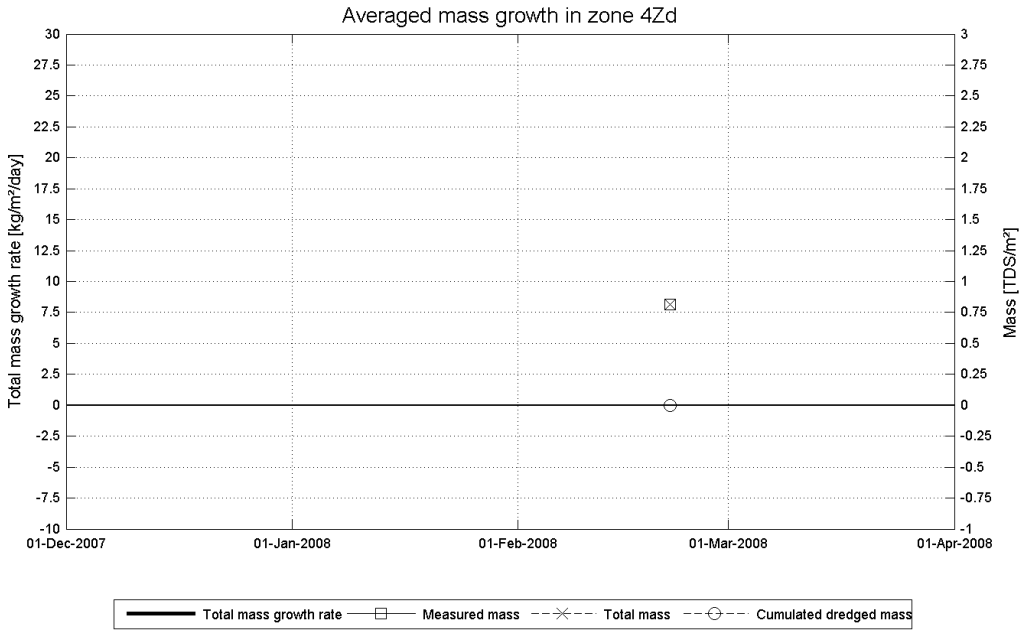
In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD





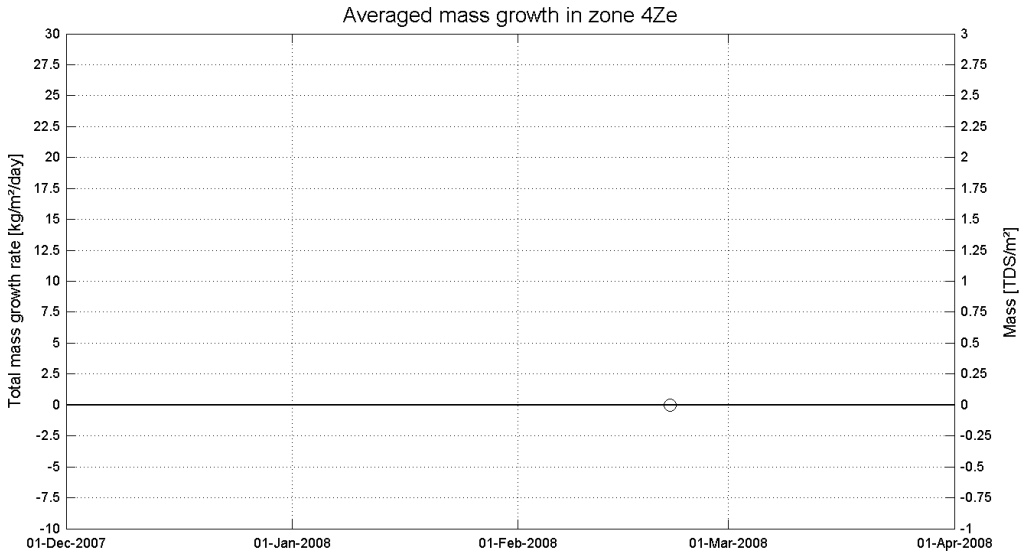
Data Processed by:

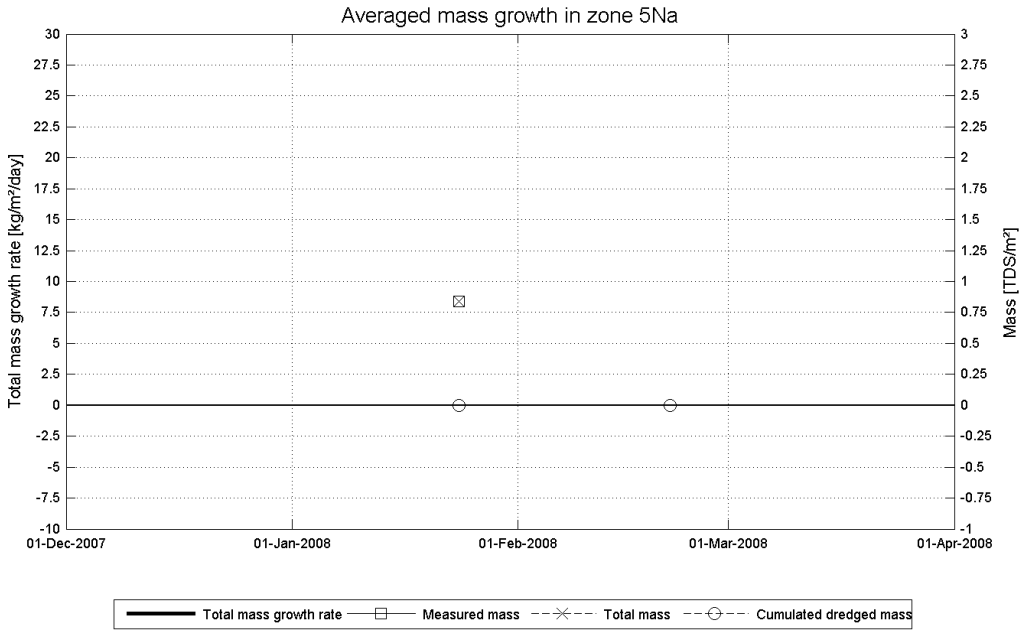
In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD





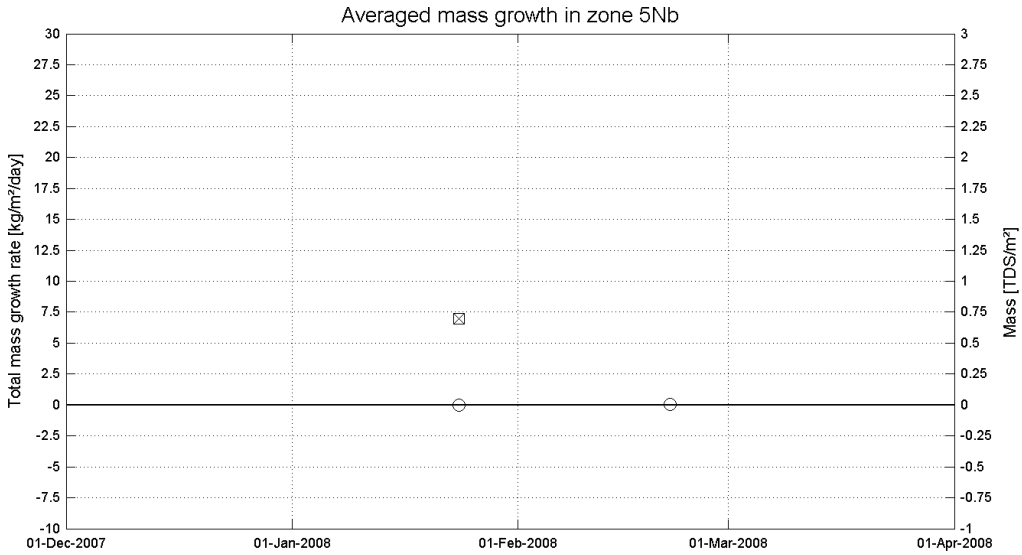
Data Processed by:

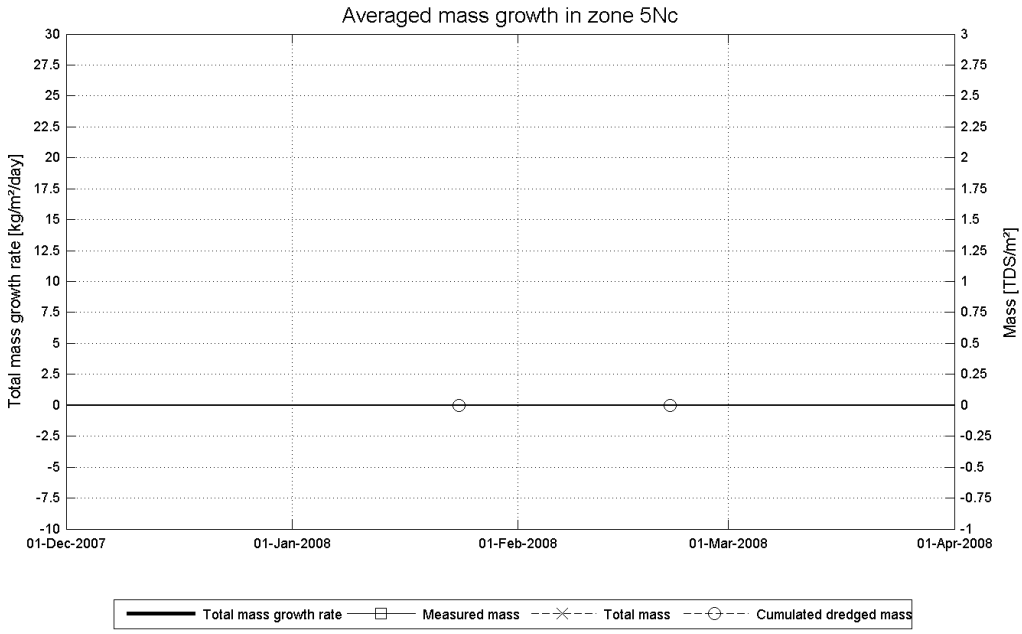
In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD





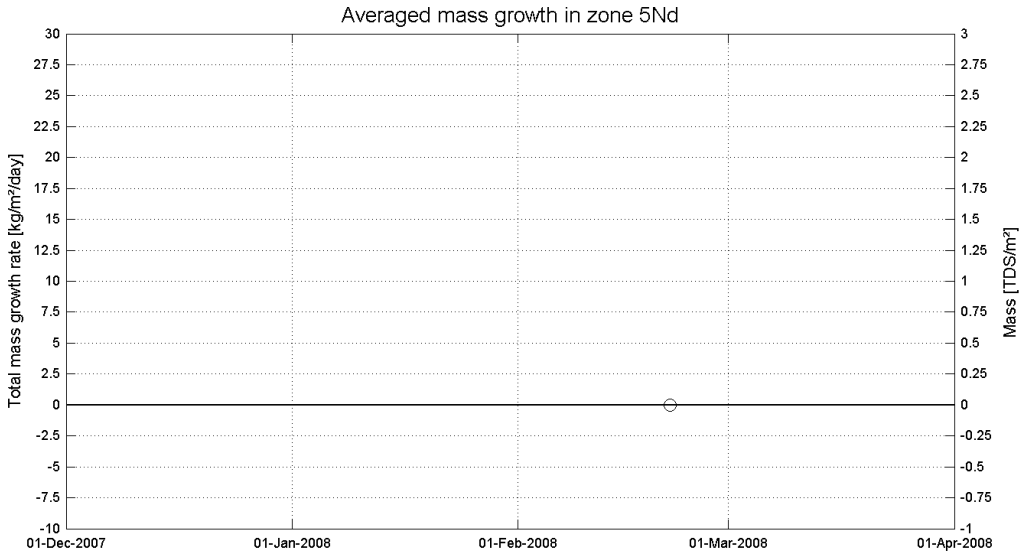
Data Processed by:

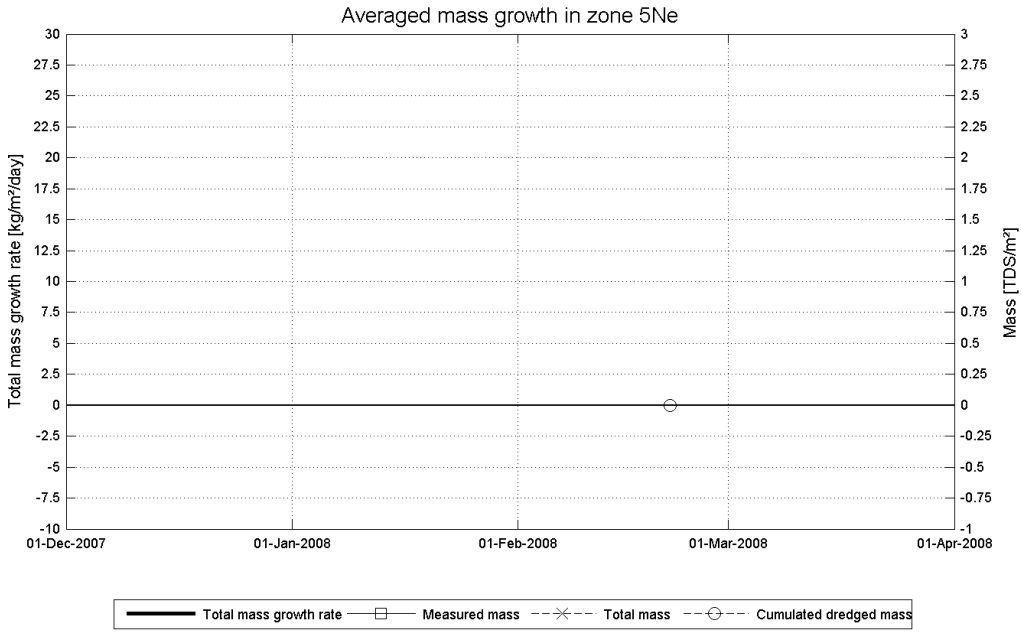
In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD





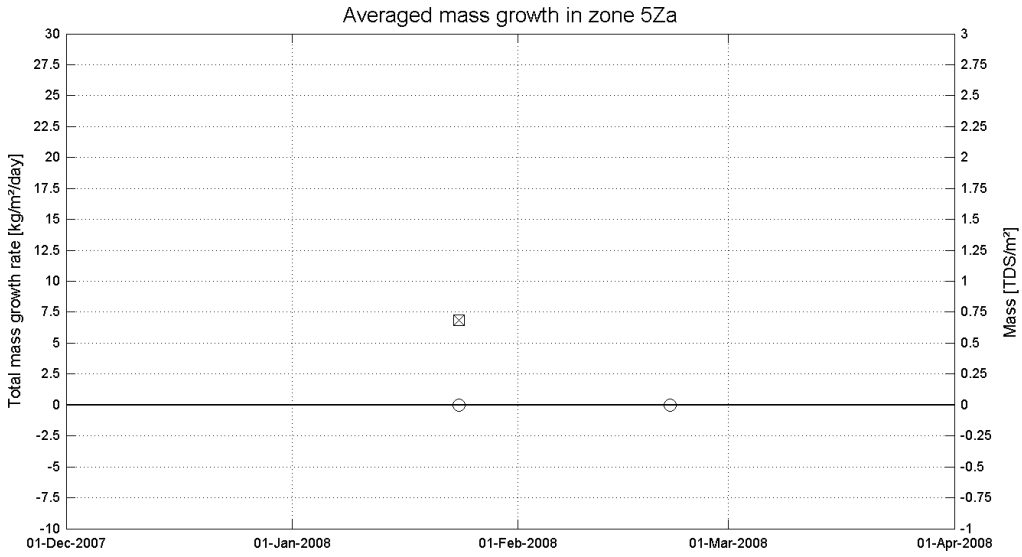
Data Processed by:

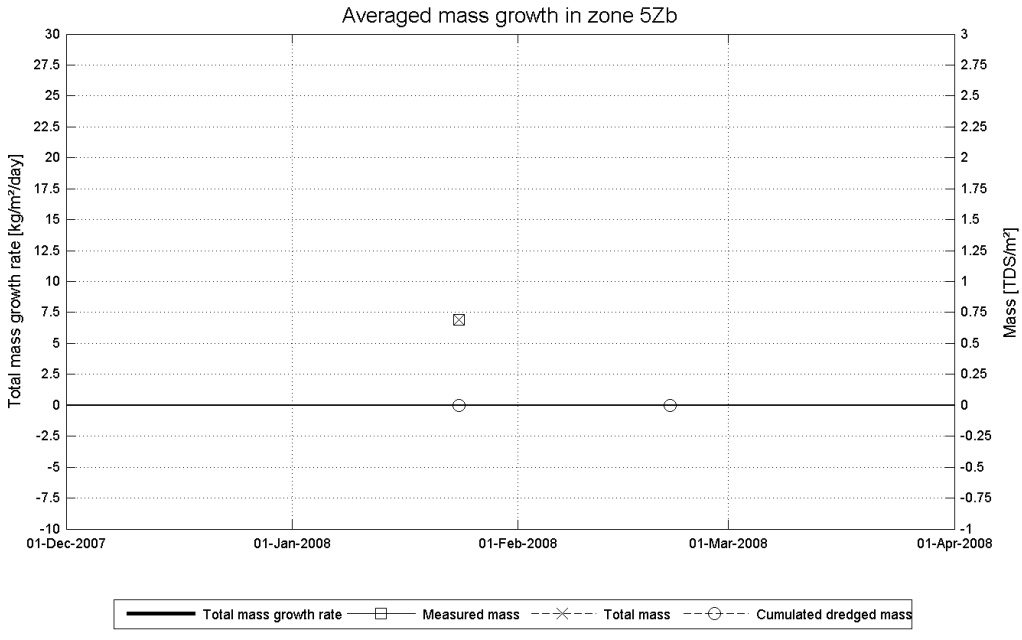
In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD





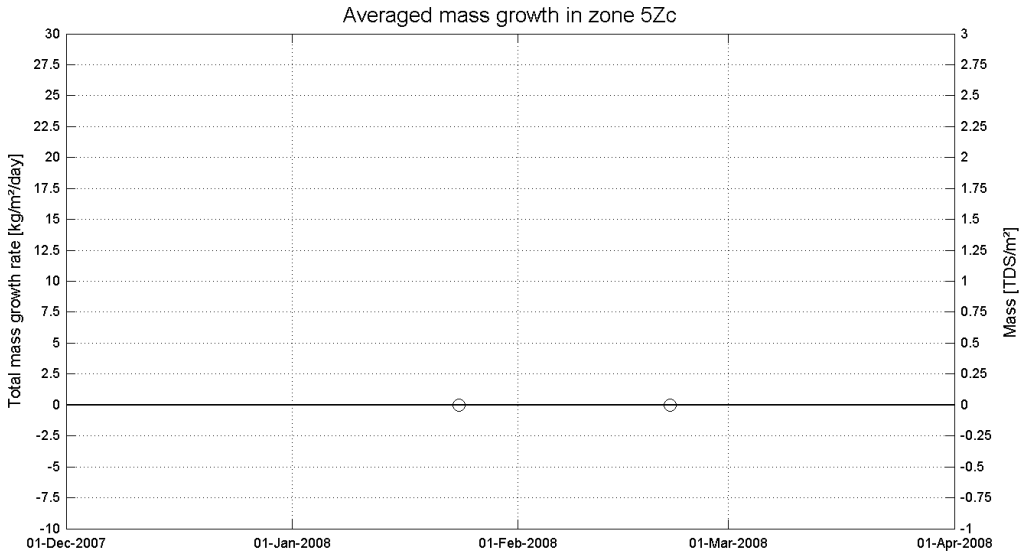
Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD



Data Processed by:

In association with :

I/RA/11283/07.084/MSA

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD

Data Processed by:

In association with :

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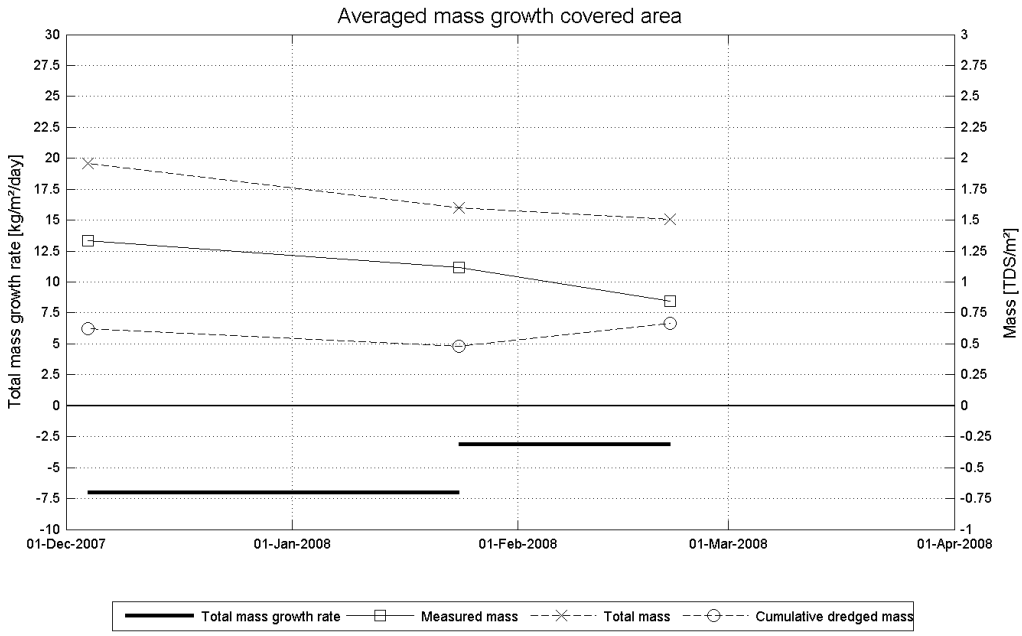
J.3 For complete Deurganckdok

Long-term monitoring siltation Deurganckdok

Measured/Dredged/Total Mass	Equipment(s): NaviTracker
	Location: DGD



Data Processed by:

In association with :

I/RA/11283/07.084/MSA

APPENDIX K.

DREDGING DATA

****Cumulative dredged mass in covered area (TDS)**

	28-Jan-08	04-Feb-08	11-Feb-08	18-Feb-08	03-Mar-08
	03-Feb-08	10-Feb-08	17-Feb-08	24-Feb-08	09-Mar-08
1	0	0	0	0	0
2	66	0	245	0	0
3a	26922	21944	32623	3686	0
3b	22553	28949	20382	995	0
3c	20491	15929	22613	868	18480
3d	159	47	248	0	39422
3e	0	0	0	0	0
4Na	4178	4774	3217	49	0
4Nb	4762	4334	1641	0	0
4Nc	2423	3436	1292	24	1952
4Nd	0	0	0	0	7220
4Ne	0	0	0	0	0
4Za	4209	1020	1838	12	0
4Zb	4779	2583	583	0	0
4Zc	1801	1389	400	0	2058
4Zd	0	0	0	0	3623
4Ze	0	0	0	0	0
5Na	0	0	0	0	0
5Nb	63	0	0	0	0
5Nc	0	6	0	0	0
5Nd	0	0	0	0	23
5Ne	0	0	0	0	0
5Za	0	0	0	0	0
5Zb	0	0	0	0	0
5Zc	0	0	0	0	0
5Zd	0	0	0	0	2
5Ze	0	0	0	0	0
Total	92406	84410	85080	5635	72780